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CANCER AND ITS RELATIONS TO PREGNANCY, TO DELIVERY, AND TO MARITAL AND SOCIAL STATUS

I. Cancer of the Breast and Genital Organs

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USUALLY mice kept virgin or castrated have a much lower incidence of breast cancer than mated mice of the same strain (Lathrop and Loeb, and Lacassagne). In women the same relationship prevails only as far as cancer of the breast appears during the reproductive age. However, more than 80 per cent of breast cancers in women develop after the age of reproduction has passed. On an average the case histories in breast cancer show fewer pregnancies with about the same percentage of nulligravidæ as in the corresponding social and age group of the general population (Weinberg and Gastpar, Lindstedt, Deelman, Peller). As to cancer of the genital organs, the situation varies even more; in the human, cancer of the genital organs is common, while in mice it is practically unknown.

At variance with the former generally accepted belief is the fact that the incidence of cervical cancer does not increase in direct relation to the number of pregnancies and deliveries (Peller, 1922). As to the frequency of cervical cancer, the first pregnancy and delivery are of much greater importance than are those which follow. As the incidence of cervical cancer due to pregnancies rises, there is more than a corresponding decrease in frequency of cancer of the body of the uterus, of the ovaries, and especially of the breast. Thus in women who have had 3 to 7 pregnancies, the total incidence of genito-breast cancer appears to be lower than in women who have had fewer or no pregnancies. On the whole, according to my clinical studies the effect of pregnancies and births upon the incidence of cancer in women is mainly (1) to transpose the primary tumors within the various parts of the body but to leave the total cancer incidence almost unchanged; and (2) to change the age at which the tumor appears.

For the first time some of these clinical findings can be tested on a nationwide statistical basis. The statistics regarding 94,400 cancer deaths occurring in England and Wales during 1930–1932 are now available for analysis and reveal marital and social status, age, organ affected, and the average number of births in 6 groups.

CANCER OF THE BREAST AND GENITAL ORGANS IN VARIOUS COUNTRIES

In most countries there are more victims of genital than of breast cancer. In England and Wales the difference has decreased more and

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TABLE I.—PERCENTAGE OF FATAL MALIGNANCIES IN WOMEN

	Uterus	Other genital organs	Mamma
United States, cities of 10,000 a. +, 1935	19	5.5	18
Canada, 1930 to 1932	17	?	21
England and Wales, 1937	13	6	20
Rome, 1930 to 1932	21	?	14
Vienna, 1931 to 1935	19	8	11.5
Berlin, 1932	22	?	12
Prague, 1929 to 1932	20	?	10
Warsaw, 1930 to 1933	18	?	8
Madrid, 1931 to 1932	21	?	5
Lisbon, 1933	35	?	13
Budapest, 1929 to 1934	33	?	9
Tokio, 1928 to 1932	34	?	4
Sydney, 1932 to 1934	16	?	19
New Zealand, 1934	15	?	27

more; since 1930 more deaths have resulted from breast than from genital cancer. Neither the frequency of genital cancer or of breast cancer, nor the proportion of each to the other has a fixed numerical relation to the birth rate (Table I).

England, the United States of America, Australia, and New Zealand, with their high percentage of Anglo-Saxons, have high ratios of breast cancer. This is also true in various countries in reference to Jewish women. German, Slavic, Magyar, and Italian populations have lower ratios, regardless as to whether the birth rate is high or low. As far as known, Spain and Japan have the lowest ratio of breast cancers.

During recent decades a change is also noted in the numerical proportion of tumors of the ovaries to tumors of the uterus. The fact that more efficient registration is now maintained does not explain the increase in ratio of ovarian cancer in England and Wales from 12.2 per cent of all genital cancers in 1911 to 1920 to 24.9 per cent in 1931 to 1935. In Vienna, of 2,685 genital cancers treated in the University Hospital during the period 1910 to 1919 only 11 per cent originated in the ovaries; in 1928 the ratio rose (according to the death certificates) to 23 per cent; and in 1934 was as high as 30 per cent.

TABLE II.—ENGLAND AND WALES. STANDARDIZED CANCER MORTALITY PER 100,000 WOMEN

	a. Breast	b. Ovary and fallopian tube	c. Uterus	d. a+b+c
1911 to 1920	17.1	2.4	17.4	36.9
1921 to 1930	18.8	3.6	15.8	38.2
1931 to 1935	19.8	4.5	13.6	37.9
1936	20.1	5.2	12.8	38.1

From the English figures one learns that during recent decades the total mortality from cancer of the breast, plus uterus, plus ovary, changed but little, in spite of the fact that there is considerable change in the rates affecting each one of these three sites. The decline in birth rate was not followed by a decline in the mortality from cancer in these three sites taken together (Table II).

RELATION OF CANCER OF THE BREAST AND GENITAL ORGANS TO MARITAL STATUS

In spinsters over 54 years of age, the mortality from breast cancer is much higher than in married women who have about the same rates as widows. The greater mortality in spinsters cannot be explained by the very small differences in the average age within each age group.

The period of physiological hormonal disturbances, the climacterium, is not especially marked. The steady increase in incidence due to increasing age is neither interrupted nor exceptionally hastened when compared with the previous or the following age decades. In single women of 45 to 54 years of age the rates rise more rapidly than in married women of the same age group (Table III).

As to cancer of the uterus, the mortality rate is higher in married women and widows than in spinsters. The difference is about twice as high in the childbearing age as in advanced age. The mortality rate in cancer of the uterus in widows over 44 years of age corresponds to that of married women one decennium older or single women about 15 to 20 years older. Thus widows of 45 to 54 years of age and married women of 55 to 64 years of age have about the same mortality rate in uterine cancer as do single women over 74 (Table IV).

TABLE III.—ENGLAND AND WALES, 1930 TO 1932. BREAST CANCER ACCORDING TO MARITAL STATUS AND AGE

	25—	35—	45—	55—	65—	70—	75—	All over 25 years	
								Crude	Standard
1. Absolute number of deaths in 1930–1932*									
Spinsters	67	385	939	1,047	453	390	517	3,798	
Married†	200	1,315	3,001	3,019	967	577	418	9,497	
Widows and divorcees	3	109	524	1,096	834	894	2,060	5,520	
2. Number of women living 1931, in thousands									
Spinsters	1,105	573	431	306	109.7	77.3	73.9	2,676	
Married§	2,203	2,222	1,897	1,213	319.1	168.9	88.2	8,111	
Widows and divorcees	41.4	159.1	305.2	440.2	263.9	247.8	341.3	1,798	
3. Average age of women at each age group, living 1931									
Spinsters	28.3	38.9	49.3	59.2	66.9	71.8	79.4	42.2	
Married	29.8	39.4	49.3	59.0	66.8	71.7	78.0	44.2	
Widows and divorcees	30.9	40.2	49.9	59.6	67.0	72.0	80.0	61.5	
4. Annual death rate per 100,000									
Spinsters	2.0	22.4	73	114	137	168	233	47.3	52.2±0.8
Married	3.0	19.7	53	83	101	114	158	39.1±0.4	
Widows and divorcees	2.4	22.9	57	83	105	121	201	102.2	41.7±0.9

*There are some differences between the figures published in the "Decennial Supplement, Part IIa, Occupational Mortality" and those given in the "Statistical Review, Text." Here as well as in the later tables figures for single and married women are taken from Table VIII of the "Occupational Mortality."

†Only one woman is below the age of 25.

§Married of all 5 social classes and of the socially undetermined group.

In cancer development, the ovaries are involved much earlier than is any other of the genital organs or the breast. This may be considered a general rule throughout the world. As age advances the percentage of ovarian cancer decreases rapidly. In women less than 35 years of age the frequency of ovarian cancer does not depend upon the marital status. As single women advance in age, the incidence of ovarian cancer is greater than is that for married women or widows. Thus in single women of 45 to 54 years of age, the incidence of ovarian cancer is about the same as that for married or widowed women of 65 to 69 years of age.

When all genital cancers are considered together, it is found that widows over 45 years of age show the same mortality rates as single women 10 years older and as married women a number of years older.

In all age groups spinsters have a higher incidence of breast than genital cancers, whereas married women, in England, have about the same incidence for both organs, and in widows cancer of the genital organs is more frequent.

When all genital and breast cancer deaths are considered together, the great differences enumerated disappear and what remains is partly the result of small deviations in the average age of the respective age group (Table III) and partly statistically insignificant or irrelevant.

Compared with those of married women, the fertility rates of single women are very low. In England, at the beginning of this century, 1000 married women between 15 and 45

TABLE IV.—ENGLAND AND WALES, 1930 TO 1932. CANCER OF THE GENITAL ORGAN ACCORDING TO MARITAL STATUS AND AGE

	20—	25—	35—	45—	55—	65—	70—	75—	All over 25 years of age	
									Crude	Standardized
1. Absolute number of deaths from cancer of:										
a. Uterus										
Spinsters	1	42	145	286	377	165	133	143	1291	
Married	6	257	1,391	2,534	2,253	725	415	249	7824	
Widows and divorcees		5	148	582	1,010	665	635	865	3910	
b. Ovary										
Spinsters	32	45	114	270	268	92	110		899	
Married	13	90	292	718	596	198	165		2059	
Widows and divorcees	1	2	25	130	218	161	294		830	
c. Vulva and vagina										
Spinsters	4	4	11	19	40	33	84		191	
Married		7	30	90	161	82	124		494	
Widows and divorcees		1	3	28	55	77	326		490	
2. Deaths per 100,000 from cancer of:										
a. Uterus										
Spinsters	0.02	1.3	8.4	22.1	41	50	57	65	16.1	17.8±0.5
Married	0.4	3.9	20.9	44.5	62	76	82	94	32.2±0.4	
Widows and divorcees		4.0	31.0	64	76.5	84	85	84.5	72.4	42.3±0.9
b. Ovary										
Spinsters	0.8	1.4	6.6	20.9	29	27.8	24.3		11.2	13.3±0.4
Married	0.9	1.4	4.4	12.6	16.4	20.6	21.4		8.5±0.2	
Widows and divorcees		1.6	5.2	14.2	16.5	20.3	16.9		15.4	8.9±0.4
c. Vulva and vagina										
Spinsters	0.08	0.1	0.6	1.3	4.4	10.0	18.5		2.4	2.1±0.1
Married		0.1	0.4	1.6	4.4	8.5	16.1		2.0±0.1	
Widows and divorcees		0.8	0.6	3.0	4.2	9.7	18.4		9.1	3.1±0.2
d. All genital organs										
Spinsters	0.9	2.8	15.6	44.3	74.6	87.8	103.8		29.7	33.2±0.8
Married	0.4	5.4	25.7	58.7	82.8	105.1	123.6		42.7±0.4	
Widows and divorcees		6.4	36.9	80.8	97.2	114.0	119.9		96.8	54.3±1.0

years of age gave birth to 235.5 children per year (1930 to 1932 the corresponding figure is 122.4), single women to only 8.5 children (1930 to 1932, to 5.8). At the beginning of the climacterium in spinsters there is a high percentage of nulligravidæ.

Thus one arrives at the following conclusions: (1) the changes connected with and following pregnancy are not apt to increase the incidence of cancer in the total complex of genital organs and breast. (2) An increase in births is followed by a transposition of the

TABLE V.—ENGLAND AND WALES, 1930 TO 1932. MORTALITY FROM BREAST AND GENITAL CANCER PER 100,000 WOMEN BY MARITAL STATUS AND AGE

	25—	35—	45—	55—	65—	70—	All over 25 years	
							Crude	Standardized
Spinsters	4.7±0.6	38±1.5	117±3.0	189±4.5	225±8.3	304±8.2	77	85.6±1.0
Married	8.4±0.3	45±0.8	112±1.4	166±2.0	206±4.6	253±5.7	81.8±0.6	
Widows and divorcees	8.8±2.7	60±3.5	138±3.9	180±3.7	219±5.3	287±3.9	199	95.9±1.3

areas of cancer origin within the organs in question, and also by a slight decrease in total cancer rates. (3) The decrease in total cancer also is partly counteracted by purely socio-economical and psychical events, such as the death of the husband.

CANCER OF THE BREAST AND GENITAL ORGANS IN RELATION TO THE SOCIAL STATUS OF MARRIED WOMEN

The differences between single and married women heretofore discussed may have been affected partly by causes other than those connected with the parturient history. The excess of females over males makes it inevitable that some women remain unmarried. Selection of the mate is influenced by sociological as well as by bioconstitutional peculiarities and by pathological conditions. The more advanced the age, the more single women deviate as a whole from the average population, with a striking increase in death rate from nervous diseases, insanity, diabetes, suicide, and from accidents.

As far as fertility is concerned, married women of the highest social class—94 births per 1000 women between 15 and 44 years of age—are much closer to the married women of the four lower classes—90, 120, 133, and 152, per 1000—than to spinsters, who on the average have a fertility lower than 6. Applying the age specific fertility rates of all married women to each of the five social classes, the highest social class would have a fertility of about 107, the second class of 120, and the laboring classes of 125, 127, and 128 per 1000. Furthermore, taking the figures for 1930 to 1932 as constant, a married woman of the first class would give birth to 2.8 children on the average, of the second class to 2.7, of the third class—skilled workers—to 3.6, of the fourth to 4.0, and the wife of an unskilled worker—fifth class—to 4.5 children. These differences must

TABLE VI.—ENGLAND AND WALES, 1930 TO 1932. AGE DISTRIBUTION OF MARRIED WOMEN AND BREAST CANCER RATES PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	25—	35—	45—	55—	65—	70—
1. Number of married women in thousands							
Married	I	46.9	64.5	60.6	39.8	10.95	9.1
Married	II	267.6	373.2	370.1	240.6	63.2	51.0
Married	III	1137.7	1085.4	867.5	524.0	134.2	105.2
Married	IV	302.9	357.2	298.8	197.9	50.4	38.8
Married	V	354.0	332.6	284.2	188.3	46.2	31.4
2. Breast cancer per 100,000							
Spinsters	All	2.0	22	73	114	137	200
Married	I	(0.6)	27	71	116	160	140.5
Married	II	3.8	22	59	101	128	173
Married	III	3.0	20	55	84	103	135
Married	IV	2.4	17	45	68	87	124
Married	V	3.2	16	42	68.5	76	112
Widows and divorcees	All	2.4	23	57	83	106	167

TABLE VII.—ENGLAND AND WALES, 1930 TO 1932. UTERUS CANCER RATES PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	25—	35—	45—	55—	65—	70—
Spinsters	All	1.3	8	22	41	50	61
Married	I	...	12	26	47	67	55
Married	II	3.1	14	35	51.5	76	94
Married	III	3.4	20	44	63.5	75	94
Married	IV	3.9	24	47	63	89	89
Married	V	6.5	29	59	75	78	99
Widows and divorcees	All	4.0	31	64	76.5	84	85

TABLE VIII.—ENGLAND AND WALES, 1930 TO 1932. CANCER OF GENITAL ORGANS PER 100,000 BY AGE, MARITAL AND SOCIAL STATUS

Marital group	Social class	25—	35—	45—	55—	65—	70—
Spinsters	All	2.7	15.6	44	75	88	104
Married	I	0.7	17.1	48	73.5	91	140.5
Married	II	5.7	20.6	49	77	116	142
Married	III	5.1	24.0	59	84	106.5	134
Married	IV	5.8	27.9	57	79	111	119
Married	V	8.5	34.2	71.5	94	100	124
Widows and divorcees	All	6.4	36.8	81	97	114	120

be taken into consideration when an analysis of cancer based on the social status is made.

The death rates for cancer of the breast diminish from the first to the fifth social class (Table VI).

If only the number of pregnancies were a factor in determining breast cancer rates, then women of the professional class—class I—would have much lower rates, and spinsters—of all classes combined—would have higher rates than they actually do. Taking into consideration the small difference in the breast cancer rates between these two groups of women one would have expected many more women of the three laboring classes to have breast cancer than they do. Therefore, factors other than fertility must be regarded as acting directly upon breast cancer incidence, or, these factors as well as pregnancy may be acting upon other organs and thus indirectly influence breast cancer rates.

Whatever factors influence breast cancer also have a similar bearing upon ovarian cancer. For cancer of both the breast and ovaries the following standard rates per 100,000 are given for all ages above 20 years: single women, 62; married women of the first class, 61; married of the third class, 46; and of the fifth class, 37. Four-fifths of the differences in rates of breast and ovarian cancer between married women of the five social classes are counterbalanced by opposite changes in the mortality rates from uterine cancer. The figures for uterine cancer in married women rise inversely with social status and run parallel with fertility rates. The differences are considerable (Table VII).

It may be stressed again that the rates of incidence for married women of the highest social class are much closer to that of single women than to any other class of married women, the standard figures for cancer of the uterus being for spinsters over 20 years of age 17, and for married women of the first, third, and fifth class, 20, 30, and 39 per 100,000, respectively. The last figure is identical with that for widows.

Summarizing the figures for all genital cancers, the standard rates for all ages above 20, rise more slowly: for spinsters, 31.6 ± 0.9; for married women of the highest social class, 33.5 ± 3.7; for women of the third social class—skilled workers, 40.4 ± 1.0; and for the wives of the unskilled workers, 47.9 ± 1.9; whereas widows, of all classes together, had a standard rate of 50.8 ± 0.9, per 100,000. The difference between the first and fifth class is 14.4 ± 4.1 genital cancer deaths per 100,000 married women; between the first and third class, 6.9 ± 3.8; between the third and fifth class, 7.5 ± 2.1; between the single women and those married to skilled workers, 8.8 ± 1.3; between single women and wives of unskilled workers, 16.3 ± 2.1; between single women and widows, 19.2 ± 1.3 per 100,000.

The age specific death rates for all cancer of the genital organs per 100,000 patients are given in Table VIII.

On an average, the social and economic status of single women is below that of married women of the first social class. If only the social factor were operative, spinsters should have a much lower rate of ovarian (and breast) cancer and a higher rate of uterine cancer than married women of the first class. This, however, does not conform with facts. From the point of view of fertility, spinsters should have higher ovarian (and breast) cancer incidence, but lower uterine cancer incidence than they actually have. Again there is a discrepancy between expectation and facts. Apparently both the biological and the social factors interfere with one another, thus levelling out the divergent tendencies. Therefore, the standardized total mortality from genital plus breast cancer for single women is very close to that of married women of the highest class. The influence of both the biophysiological and the

TABLE IX.—ENGLAND AND WALES, 1930 TO 1932. MORTALITY FROM CANCER OF BREAST AND GENITAL ORGANS

Marital status	Social class	20—	25—	35—	45—	55—	65—	70—	Standard mortality for all over	
									20	25
									years of age	
Spinsters	All	0.9	4.7	38	117	189	225	304	81	86
Married	I		1.4	44	119	190	253	281	83	87.6
Married	III	1.4	8.1	44	114	168	208	269	79	82.8
Married	V	1.5	11.7	51	113	162	176	236	78	82.3
Widows and divorcees	All		9.0	60	138	180	220	287	90	96

sociological factors has to be considered also in comparing married women and widows. The latter have much higher death rates than the average married women; this is especially true in the age groups 35 to 44 and 45 to 54 (Table IX).

In the ages above 45 the combination of a higher birth rate with a lower social status does not raise the mortality of the total of breast and genital organs but rather lowers it. Decline in birth rates does not diminish but rather increases the incidence of genito-breast cancer, regardless as to whether the decline is associated with a higher or a lower standard of life. The effect of both, biological factors—pregnancies—and social status, upon the total mortality from breast and genital cancer combined is clearly evident in the age specific death rates; the effect is, however, much less evident if standardized rates are used.

ANALYSIS OF STUDY

It has been shown that all three conditions, namely, the lowering of the social and economic status, the increase in birth rate, and the condition following the death of the husband, tend to increase mortality from cancer of the uterus, whereas the percentage of breast cancers is increased by the third, and lowered by the first two conditions. The compensatory relations between the two—the genital and breast cancer—are obvious by comparing statistics for nulligravidæ with those for gravidæ, or of oligoparæ with those of multiparæ, or of those for spinsters with those of married women; this relation is lacking, however, if statistics for married women are compared with those for widows. Widows have higher breast cancer rates in spite of the fact that they have higher rates of genital cancer. The fact has been established that changes in social standards, either improvement or deterioration, and tragic family events primarily influence the age at which the cancer manifests itself. Differences of 10, 20, or even more years due to marital status have been shown here. That is of importance in itself and to the question as well, as to whether the cancer campaign could use the principle of prolonging the average life without changing the total number of cancer victims.

SUMMARY AND CONCLUSIONS

1. The distribution of primary neoplasms within the breast and genital organs, and the age specific death rates from cancer of each part are widely influenced by *birth rates;* the total mortality from cancer of the breast and genital organs, however, varies only to a small degree, as an increase in incidence in one organ is compensated for by a decrease in incidence in other organs, and vice versa. The compensation is not an exact one, for populations with higher birth rates have a rather diminished mortality. These findings are corroborated by my clinical studies (1922 to 1923).

2. From the standpoint of *social status* the changes in the incidence of uterine cancer and breast cancer become apparent. These changes are independent of those due to purely biological relations, that is fertility and cancer rate.

3. In contradistinction to the factors considered under (1) and (2), circumstances attendant upon the *husband's death* are apt to increase the mortality from both uterine and

breast cancer, and so to change the age specific frequency of cancer affecting both organs.

4. The lower the social level and the less satisfactory the *marital status*, the earlier the patient manifests cancer or dies from it.

5. The correlation between cancer and pregnancies in *women* is entirely different from that in *mice*.

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NUPERCAINE ANESTHESIA

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IN the literature there is a broad and comprehensive discussion of anesthetic agents and indications for each. Among the more recent publications Sise (10) presents a summary of the agents and methods. It is our purpose, first, to discuss a limited phase of anesthesia, subarachnoid block or spinal anesthesia, and one particular agent, namely, nupercaine[1], also known as percaine, and second, to present a report of our series of cases in which the Lahey clinic technique, adapted by Woodbridge from Jones and Hewer, was employed.

Rapid strides have been made in spinal anesthesia from the original studies with cocaine. From cocaine, allied substances have been evolved, namely, procaine, metycaine, and the more recent agent, pontocaine. The goal of investigators, pharmacologists, and clinicians has been an agent that would combine the important factor of lessened toxicity with increased duration of anesthesia. Of this group, pontocaine approaches most closely the ideal agent for spinal anesthesia. However, it has two important limitations: first, the relation of the specific gravity of the present 1 per cent solution to the varying specific gravities of the different spinal fluids, and second, the duration of anesthesia to be anticipated. We believe the first limitation is remedied by insuring a hyperbaric solution with the addition of 10 per cent glucose solution and depending on gravitational methods for anesthetic levels, as reported by Sise (11). The usual duration of anesthesia with pontocaine varies from 1½ to 2½ hours, depending on the dosage and site of operation. For the majority of operative procedures, therefore, pontocaine glucose mixture is, at the Lahey clinic, the anesthetic agent of choice. With this technique the height of anesthesia is accurately controlled and the onset is rapid.

With certain operations it is desirable to have anesthesia of longer duration than that produced by pontocaine, but without any increase in depressive effects; in others a hypobaric solution is preferable because of the position of the patient during operation. In these cases we have selected nupercaine, 1:1500 dilution. Therefore, the use of this drug is limited to two general types of operation: first, long upper abdominal operations, chiefly gastric resection; and second, operations of positional importance in which a hypobaric solution is indicated. Due to the limitations noted the number of these cases is necessarily small.

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[1] Ciba, for spinal anesthesia.

CHEMISTRY

Nupercaine synthesized by Miescher is alpha-butyloxycinchoninic acid di-ethyl-ethylene-diamide hydrochloride. It is a colorless, odorless, tasteless, crystalline substance with a neutral reaction, readily soluble in water and alcohol, and may be boiled repeatedly without decomposition. In a solution even slightly alkaline the drug precipitates as a free base. The solution now used at the Lahey clinic is that supplied by the manufacturers in 20 cubic centimeter sterile ampuls of 1:1500 dilution in 0.5 per cent sodium chloride. The specific gravity of this solution Jones reports as 1.00345 at 35.5 degrees Centigrade. Levinson presents a table of specific gravity readings of spinal fluid varying from 1.001 to 1.010.[2] Therefore this solution, with very few exceptions, is hypobaric or lighter than spinal fluid.

PHARMACOLOGY

Accurate pharmacologic investigation by Lipschitz and Laubender has shown nupercaine, by intravenous injection, to be twice the toxicity of cocaine when injected into rabbits.

Saklad, reviewing the work of Nowak and of Wiedhopf, presents an excellent compara-

[2] The specific gravity readings of spinal fluids as compiled by Levinson: Hoppe, 1.001 to 1.005; Halliburton, 1.007 to 1.008; Kazka, 1.002 to 1.008; Zdareck, 1.007; Polanyi, 1.005 to 1.007; Mestrezat, 1.007; Nawratzat, 1.008; Penda, 1.007 to 1.010; Borelli and Data, 1.007 to 1.009; Williamson, 1.005 to 1.009; Hammerstein, 1.007 to 1.008; Eskuchen, 1.006 to 1.007; Levinson, 1.003 to 1.007.

tive summary of the fatal intravenous doses of the various agents. Nowak found that in cats the average fatal dose of procaine was 49.6 milligrams per kilogram; for metycaine the average fatal dose was 28.8 milligrams per kilogram, the ratio compared to procaine 1.7, the dose ratio 0.8, the corrected toxicity ratio compared to procaine 1.36; for pantocain the average fatal dose was 8.6 milligrams per kilogram, the ratio compared to procaine 5.8, the dose ratio 0.1, the corrected toxicity ratio compared to procaine 0.58; for nupercaine the average fatal dose was 3.5 milligrams per kilogram, the ratio compared to procaine 14.2, the dose ratio 0.05, the corrected toxicity ratio compared to procaine 0.71. Wiedhopf found that in rabbits the average fatal dose of procaine was 57.5 milligrams per kilogram; for pantocain the average fatal dose was 8 milligrams per kilogram, the ratio compared to procaine 7.18, the dose ratio 0.1, the corrected toxicity ratio compared to procaine 0.71; for nupercaine the average fatal dose was 3 milligrams per kilogram, the ratio compared to procaine 19.16, the dose ratio 0.05, the corrected toxicity ratio compared to procaine 0.958.

Gessner and Nauheimer report nupercaine to be 7 to 50 times more effective than novocain, and in dilute solutions to have very little effect or a slight dilating action on the vascular channels of warm blooded animals.

W. H. Jones states: "By laboratory test percaine is proved to be ten times stronger than cocaine and twenty times stronger than novocain, and therefore far more toxic than either, but as toxicity is in a great measure dependent on concentration and percaine is effective in extreme dilution, toxicity, in practical use, is reduced to such a level that symptoms are not produced."

TECHNIQUE, PRECAUTIONS, AND SUPPLEMENTARY ANESTHESIA

The members of the department of anesthesia at the Lahey clinic are firm advocates of adequate pre-operative medication. For "good risk" patients our average pre-operative medication consists of ⅓ grain pantopon, 1/150 grain scopolamine, subcutaneously, 2 hours before the scheduled time for operation; and 3 grains nembutal, by mouth, 1 hour before operation. In cases of vomiting, obstruction, or when for any reason oral medication is contra-indicated, the nembutal is given by rectum. We prefer pantopon to morphia, as our clinical impressions suggest less incidence of nausea and vomiting during the operative procedure. This observation is being statistically reviewed at the present time by members of our department. The doses of pre-operative medication are elastic, and depend on the opinion of the anesthetic risk formed when the anesthetist interviews the patient the day before operation.

When patients arrive in the operating suite they are usually in a drowsy or euphoric state of mind, ideal for surgery on conscious patients. Occasionally there is little or no effect from their pre-operative medication. With these cases previous medication is reinforced with varied doses of morphia and scopolamine intravenously, usually 1/6 to 1/12 grain morphia, 1/200 or 1/300 grain scopolamine, either just prior to spinal puncture or preferably after the desired anesthetic level has been obtained, so as to insure the optimal co-operation of the patient.

All patients for spinal anesthesia are given 50 milligrams of ephedrine sulphate intramuscularly as the first step. We feel that, within reason, the greater the time interval between the ephedrine and the anesthetic solution injection, the better the inhibiting response on blood pressure fall that may occur following injection of the anesthetic solution.

For operations in the upper part of the abdomen the dose of nupercaine solution varies from 16 to 20 cubic centimeters. The height and sex of the patient determine the proper dose: 16 cubic centimeters for a 5 foot woman and 17 cubic centimeters for a 5 foot man; for every 3 inches over 5 feet, 1 cubic centimeter of nupercaine solution is added; 20 cubic centimeters is the maximal dose. For anesthesia lower than the area mentioned, divide 100 by the number of the uppermost thoracic nerve segment which is to be anesthetized. The result is the quantity, in cubic centimeters, of nupercaine solution to be used. For example: anesthesia desired to the umbilicus, innervated by the ninth thoracic nerve, 100

divided by 9 equals 11; thus the estimated dose will be 11 cubic centimeters of nupercaine solution.

While we do not advocate rigid doses for any drug but feel rather that the dose depends on a number of factors, all of which should be considered in estimating its size, the authors believe that with nupercaine, 1:1500 dilution, it is the volume of the solution that is the important factor in obtaining the optimum anesthesia, both in desired level and in duration of anesthesia. Occasionally the risk of the patient influences the dosage, by not more than 1 or 2 cubic centimeters of solution.

Before proceeding with the discussion of the technique proper, we wish to mention two important preliminary steps in anesthesia with nupercaine. First, we recommend that both the ampul of nupercaine solution and the 20 cubic centimeter syringe be warmed to at least body temperature and preferably slightly above. We believe this procedure is an aid in obtaining a satisfactory and evenly distributed anesthesia. Second, as nupercaine is precipitated in the presence of an alkaline medium it is important to insure a slightly acid reaction in the spinal needle and 20 cubic centimeter syringe. Since the nupercaine solution as prepared by the manufacturer has a slightly acid reaction, 1 cubic centimeter is effective as a rinsing solution for syringe and needle to assure that they contain no trace of alkalinity. The 1 cubic centimeter of solution which has been used for rinsing may now be transferred to a 2 cubic centimeter syringe with the addition of a small quantity of normal saline solution to increase the bulk, and be used as the anesthetic agent for local infiltration at the site selected for lumbar puncture.

For all spinal punctures we use the combination of the Lahey clinic introducer and gold needle. This needle is of a No. 21 gauge with stilet. The use of the introducer is almost a necessity in piercing the highly resistant interspinous ligament with such a limber needle (Fig. 1).

The most satisfactory site for spinal puncture in upper abdominal cases with nupercaine anesthesia is the second lumbar interspace. Our clinical experience has shown greater consistency in obtaining the desired anesthetic

Fig. 1. Lahey clinic gold needle and introducer.

levels in upper abdominal operations when this interspace is used rather than the lower lumbar interspaces. After local infiltration with the solution mentioned, puncture is made with the patient lying on his left side in the level position. We prefer to withdraw and discard approximately 5 cubic centimeters of spinal fluid for two reasons: (1) to lessen any tendency to sudden severe headache that might occur during the injection of this volume of solution, and (2) to insure a more consistent anesthesia. Next, the previously estimated and prepared warm anesthetic solution is injected at the rate of 0.5 cubic centimeter per second. Immediately following this injection, the patient is turned to a prone position, without pillows under the head.

In pelvic or lower abdominal surgery a level or a slight Trendelenburg prone position is sufficient for anesthesia, and the patient is returned to supine position and may be placed immediately in steeper Trendelenburg position. In upper abdominal operations we wish the height of anesthesia to reach approximately to a level between the second and fourth thoracic nerve segments. In order to make the light nupercaine solution run to the desired position in the spinal column, by means of a thyroid bar under the upper portion of the patient's sternum (Fig. 2, a), we raise these areas to approximately a 15 degree angle to a horizontal plane, with special care that the head of the patient is lower than the uppermost thoracic area. This procedure causes the solution to flow to and settle in the highest region of the spinal canal, which in this position is approximately between the second and fourth thoracic segments, and prevents the solution from running high enough to involve the important cervical roots from which the phrenic nerves arise. When a thyroid bar is not available the patient may be placed prone with his head and arms over the end of the operating table and the table may then be tilted to 10 or 15 degrees—Fowler position—(Fig. 3), special care being taken that

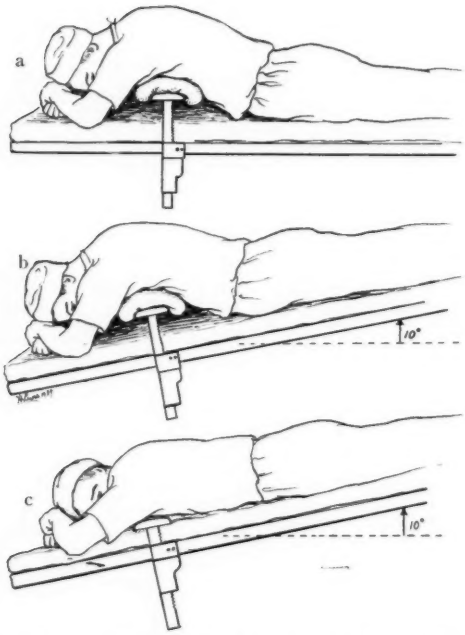

Fig. 2. a, Recommended position of patient for obtaining desired height of anesthesia. b, Position after obtaining height before thyroid bar is lowered. c, Position after lowering thyroid bar prior to turning patient supine.

the patient's head and neck are always lower than the upper thoracic level.

By means of a pinching clamp to elicit definite response to pain stimulus, we test for the height of anesthesia within 2 minutes after injection. This is usually done along the right axillary line though it must be borne in mind that in a few instances anesthesia will be found at a higher level on the left. The usual lapse of time to obtain the desired level of anesthesia ranges from 4 to 12 minutes.

When anesthesia has reached the desired level, first the table is placed at a 5 to 10 degree Trendelenburg position (Fig. 2, b), and second, the thyroid bar is completely lowered under the patient's sternum (Fig. 2, c). Only after Trendelenburg position has been assured to prevent further cephalad rise of anesthesia, should the patient be turned supine. Here again, as always with this technique, care should be taken to have the head of the patient in the most dependent position. By

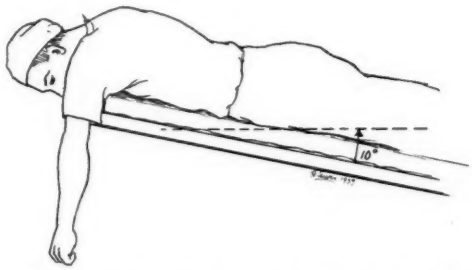

Fig. 3. Optional position for obtaining desired height of anesthesia.

the time the anesthetist has completed his preparations and the patient is ready for operation, anesthesia will usually be found to be one to two segments cephalad to the segment tested in the prone position.

Rarely, we find that a level of anesthesia is obtained more rapidly and possibly higher 2 to 4 minutes after injection, and that it has extended higher than desired. It is for these cases one must be on the alert by early and frequent testing. When one encounters such cases the patient should immediately be placed in 10 degree Trendelenburg position and the lift bar completely lowered, leaving the patient in the same prone position for approximately 7 to 8 minutes, if his condition permits. This insures a complete bathing of the sensory or posterior nerve roots by the hypobaric anesthetic solution and also causes this solution to retreat somewhat from its extended position so that when the patient is turned supine the anterior or motor roots will not be affected as far cephalad. These patients occasionally have upper intercostal paralysis for a brief period. The mental state of the patient and the objective degree of paralysis will then influence further procedure. Usually light supplementary anesthesia will suffice to alleviate the disturbed mental state of the patient. If the patient is kept abundantly supplied with oxygen, it is remarkable how little disturbance is caused him even by considerable respiratory paralysis.

A peculiar type of reaction occasionally occurs with this method of anesthesia. One to 2 minutes after the patient is placed in the prone position, shoulders elevated, head lowered from the highest point of elevation, there

occurs a severe fall in the patient's blood pressure, almost to a pulseless state, with an associated state of unconsciousness. Early frequent questioning by the anesthetist soon elicits the change in the patient's response, from the halting, slurring speech to a state of unconsciousness with no other premonitory symptoms such as retching or nausea. This reaction is probably due to cerebral anemia from a number of factors, the prone position with elevation of the shoulders probably being the chief contributing factor.

The original method of treatment was Trendelenburg position, lowering the shoulders and then turning the patient to a supine position. The response was almost immediate, with return of consciousness and improvement of blood pressure to approximately the former normal level. This change in position, however, usually interfered with the induction of anesthesia. The prone technique was therefore re-employed in an attempt to obtain the desired height of anesthesia.

In a few of our recent cases the new cardiovascular stimulant reported by Melville, Raginsky (7), and Bourne (8), has been used intravenously with as satisfactory a response as obtained by a change in position. The method employed is an intravenous injection of approximately 2 to 3 minims of a previously prepared mixture of posterior pressor principle of the pituitary gland and ephedrine into the tubing of the already functioning constant infusion apparatus. This procedure permits the patient to remain in the original prone position, thus assuring the desired height of anesthesia with no apparent untoward effects on the patient.

The recommended solution is a balanced mixture of 5 units of posterior pressor principle, the trade name of which is "pitressin," and 3/8 grain or 25 milligrams of ephedrine. This combination is an excellent cardiovascular stimulant, for two reasons: first, small doses can safely be given intravenously and give immediate pressor response; second, if the total dose is also given subcutaneously it not only improves the vascular tone but retains it at the improved levels for an appreciable period of time. Repeated doses can be given subcutaneously or intravenously.

Failures with this technique of anesthesia have been few. In cases in which sensory effect has been insufficient, motor relaxation has been excellent and usually of from 3 to 3½ hours' duration. In these cases sensation has been satisfactorily obliterated by a light supplementary anesthesia. This supplement can be either by inhalation or by intravenous administration.

REPORT OF CASES

The total number of cases in which nupercaine anesthesia was employed up to September, 1938, is 251. In the majority, numbering 180 cases, the 1:1500 solution and the technique described were used to obtain the desired anesthesia. During the period of investigation, (a) 38 patients were anesthetized with this technique but 1:1000 solution was used, and (b) 33 patients were anesthetized with the 1:1500 solution but varying sites of injection and position were used. A detailed case report will be made concerning the 180 cases. The remaining series of 38 and 33 cases, respectively, will be grouped together, numbering 71 cases, and will be presented by tables under the consideration of complications.

We present our small series of cases numbering 180, keeping in mind the limitation in the use of nupercaine to two general types of operation: first, operations that we suspect will continue beyond the usual duration of anesthesia safely obtainable with the other agents commonly employed; second, operations of positional importance in which the hypobaric solutions and methods are indicated rather than the hyperbaric solutions. The first type for future reference will be classified as the group of necessity or Group A. The second type for future reference will be classified as the group of election or Group B.

Operation. The vast majority of operations under nupercaine anesthesia were major surgical procedures on serious risk patients. Table I lists the type, number, and percentage of total cases, divided into Groups A and B.

In Group A under gastric surgery are included gastric resection, total and subtotal; lysis of malfunctioning gastro-enterostomy; gastrostomy and gastro-enterostomy; resection for gastrojejunocolic fistula involving re-

TABLE I.—NUMBER AND TYPE OF CASES

Type of cases	Number	Per cent of total
Group A		
Gastric surgery	111	61.7
Biliary tract surgery	10	5.5
Large bowel surgery*	13	7.2
Small bowel surgery	4	2.2
Total	138	76.6
Group B		
Pelvic organ surgery	21	11.7
Kidney, ureter and bladder surgery	12	6.7
Lumbar sympathectomy surgery	6	3.3
Appendectomies	3	1.7
Total	42	23.4
Grand total	180	100

*Excluding appendectomy.

TABLE II.—GRADE OF RISK

		Grade of risk				Total cases
		I	II	III	IV	
Group A	Gastric surgery	5	62	41	3	111
	Biliary tract surgery	5	3	2	0	10
	Large bowel surgery (except appendectomy)	1	11	1	0	13
	Small bowel surgery	0	3	1	0	4
	Total	11	79	45	3	138
Group B	Pelvic organ surgery	7	14	0	0	21
	Kidney, ureter and bladder surgery	6	6	0	0	12
	Lumbar sympathectomies	0	6	0	0	6
	Appendectomies	2	1	0	0	3
	Total	15	27	0	0	42
Total number in A and B		26	106	45	3	180

section of colon, jejunum, and stomach in one stage, resection for gastro-enteric fistula and gastrocolic fistula. In biliary tract surgery are included cholecystectomy (frequently a secondary operation), and plastic repair of the biliary duct. Large and small bowel surgery comprises one stage resections of the rectum; resection for ulcerative colitis; resection for carcinoma of the cecum; resection for multiple enterocolic fistulas secondary to tuberculosis or typhoid fever; resections for terminal or regional ileitis; and plastic operations for malfunctioning entero-enterostomies.

In Group B under lower abdominal or pelvic organ surgery are included panhysterectomies, removal of endometrial pathology, plastic repair of vesicovaginal and vaginorectal fistulas, transvaginal hysterectomies, and extensive combined perineal pelvic repair. Kidney, ureter, and bladder surgery comprises nephrectomies; plastic surgery on kidney, pelvis, and ureters; and resection of bladder with transplantation of ureters. In sympathectomy surgery are included lower lumbar splanchnicectomies and ganglionectomies. Finally, in this group are 3 appendectomies; 2 appendices in which serious abdominal pathological conditions were anticipated, but no lesion was found.

AGE AND DOSE

While no detailed record of age was charted, the ages ranged from the second to the eighth decades of life. The average was in the usual cancer decades of the sixth and seventh. Age influenced our dosage only as it affected the estimated grade of risk. The determining factors of dosage have already been mentioned earlier in this paper.

RISK

As already published by Woodbridge: "Every available item that might affect the ultimate outcome of anesthesia and of operation is considered in determining the operative risk that each patient presents. These include, in addition to the other items, the age; vigor; degree of anemia, of dehydration, or of starvation; cardiac and respiratory reserve; diseases of liver, kidneys and metabolism; fever; length of confinement to bed; and prognosis of the surgical disease. Risk I means that no condition is known to be present that would affect the outcome unfavorably. Risk II means that some factor or factors of moderately unfavorable influence are present, whether they are part of the surgical disease or not. Such factors might be age of sixty years or beyond, a head cold, or a moderate anemia. Risk III is a danger signal, and means that the patient is in such poor condition that any depressing form of anesthesia or any markedly shock-producing type of operation should be avoided if possible. Risk IV means that a fatal outcome may be expected."

The pre-operatively determined grade of risk occasionally influences our dosage; usually to a small degree, i.e., by not more than 1

cubic centimeter of anesthetic solution. Table II lists the grade of risk and is of considerable interest and an excellent index of the type of case in which this anesthetic agent was used.

In group B there are no poor risk patients. In group A, predominantly gastric surgery, there are very few patients listed as risk I, the majority are risks II and III and a few are risk IV. The duration of anesthesia with a minimal depressive effect, characteristic of this dilution of nupercaine, lessens operative hazards in these serious risk patients.

SUPPLEMENTARY ANESTHESIA

The usual indications for supplementary agents with spinal anesthesia are: (1) an unsatisfactory choice of drug resulting in inadequate anesthesia; (2) a faulty technique resulting in insufficient length and height of anesthesia; or (3) inadequate pre-operative medication resulting in unpleasant responses during operation, such as mental anxiety, restlessness, discomfort outside the operative field, or idiosyncrasies resulting from medication. This series of cases with nupercaine anesthesia tends to refute the first two assumptions concerning this drug and technique. Table III lists the non-supplemented and supplemented cases of groups A and B.

We wish to call attention to the very small percentage of supplemented cases in group B. The majority of supplemented cases in group A were gastric resections of moderate to prolonged duration, in which undesirable reflexes to the operative procedures are frequent, even when actual pain is lacking.

Choice of drug. Rather than an unsatisfactory choice of drug, nupercaine is extremely satisfactory and is chiefly employed in those operations in which inhalation agents and methods might result in an injurious effect on metabolic functions or might interfere with the optimal surgical procedures, or in which other spinal anesthetic drugs are unsatisfactory either through insufficient duration of anesthesia or because of greater depressive effects. Thus nupercaine facilitates operations which otherwise might be considered unwise to perform on poor risk patients.

Supplementary anesthesia for insufficient duration of nupercaine spinal anesthesia was resorted to in 10 cases. A résumé of these individual cases will be self-explanatory as regards the necessity of a supplement for motor relaxation (Table IV). The average duration of motor relaxation with the doses recommended in upper abdominal operations is from 3 to 3½ hours. In lower abdominal operations the duration of anesthesia is frequently dependent on the total dosage of drug.

TABLE III.—SUPPLEMENTARY ANESTHESIA

Type of cases	Not supplemented	Supplemented	Per cent supplemented
Group A			
Gastric surgery	48	63	56.8
Biliary tract surgery	5	5	50
Large bowel surgery (except appendectomy)	9	4	30.8
Small bowel surgery	1	3	75
Total in Group A	63	75	54.3
Group B			
Pelvic organ surgery	15	6	28.6
Kidney, ureter and bladder surgery	9	3	25
Sympathectomies	6	0	0
Appendectomies	3	0	0
Total in Group B	33	9	21.4
Total in A and B	96	84	46.6

Technique. A faulty technique results in inadequate height or length of anesthesia. Ninety per cent or 75 of the cases of nupercaine spinal anesthesia requiring supplementary anesthesia were in group A, and 84 per cent or 63 of these operations were major procedures of gastric surgery, chiefly resection. The major portion of these supplemented cases is classified as insufficient height or length of anesthesia. The desired anesthetic height in gastric surgery is between the second and fourth thoracic nerve segments. Spinal anesthesia involving higher or more cephalad levels results in an increase in disturbance of respiration because of more extensive intercostal paralysis, a decidedly undesirable occurrence in any operation.

To quote a previous paper (2) relating to this type of surgery, "In all operations of this type (gastric surgery) there are moderate to marked degrees of manipulation and traction on the stomach and esophagus with disturbance of the diaphragm and mediastinal structures. Disturbance of these areas in a conscious patient results in a cycle of nausea and retching with associated drop in blood pressure.

TABLE IV.—CASE RÉSUMÉ: INSUFFICIENT DURATION OF ANESTHESIA

Sex Age	Height	Dosage nupercaine in c.cm. 1:1500 dilution	Grade of risk	Operation	Duration of operation, hours	Supplementary agent	Why supplemented	Duration of supplementary anesthesia, hours	Postoperative course of patient
F 59	5′	16	2+	Gastric resection for gastrojejunal ulcer	3⅙	C_3H_6	Discomfort and increasing muscle spasticity	¼	Uneventful
M 31	6′	20	2	Gastric resection for duodenal ulcer with obstruction	2½	C_3H_6	Muscle spasticity for abdominal closure	¼	Uneventful
M 43	5′	17	2+	Resection of transverse colon, jejunum, and stomach for fistulas	4¼	Pentothal Ether	Mental anxiety Muscle spasticity of abdomen	2½ ½	Uneventful
F 62	Group B evaluation	13	2+	Perineal repair and hysterectomy	1¾	C_3H_6	Discomfort and abdominal spasticity	⅓	Died 5 days postop., pulmonary embolus
F 49	Group B	12	1	Perineal repair and hysterectomy	2½	C_3H_6	Discomfort and abdominal spasticity	¾	Postop. intra-abdominal hemorrhage 3 hr. later; recovered and uneventful
M 48	5′6″	19	3	Gastric resection for gastrojejunal ulcer	3½	C_3H_6	Abdominal pain	½	Uneventful
F 49	5′3″	17	2	Gastric resection for duodenal ulcer	2	C_3H_6	Mental anxiety and abdominal discomfort	½	Uneventful
M 56	5′	16	2	Carcinoma of rectum; second stage Lahey resection	2	C_3H_6	Perineal discomfort	¼	Uneventful
M 58	5′6″	19	2	Gastric resection for duodenal ulcer	2½	C_3H_6	Mental anxiety Abdominal spasticity	2 ½	Uneventful
M 33	5′10″	20	2	Gastric resection for gastrojejunal ulcer	3½	C_3H_6 C_3H_6+ vinyl ether	Mental anxiety Abdominal spasticity	2 ½	Uneventful

This cycle has two very undesirable results: (1) It increases technical difficulties and may result in spilling of gastric or intestinal contents; and (2) it results not only in considerable discomfort for the patient but also in changes in vascular tone that might increase operative hazards. Therefore, one must guard against extensive intercostal paralysis, increased technical difficulties and mental or physical discomfort to the patient. It is with increasing frequency that we begin supplementary anesthesia for alleviation of sensory disturbance at the earliest indication. . . ." This quotation concisely summarizes the reason for the use of supplementary anesthesia in this group classified as insufficient height or depth of anesthesia.

TABLE V.—INFLUENCE ON BLOOD PRESSURE

	Class of blood pressure fall	Not supplemented				Supplemented				Total
		1	2	3	4	1	2	3	4	
Group A	Gastric surgery	14	15	9	10	19	18	19	7	111
	Biliary tract surgery	1	2	1	1	2	2	1	0	10
	Large bowel surgery (except appendix)	2	3	4	0	0	3	1	0	13
	Small bowel surgery	0	0	0	1	1	2	0	0	4
	Group A total cases	17	20	14	12	22	25	21	7	138
Group B	Pelvic organ surgery	6	4	5	0	2	3	1	0	21
	Kidney, ureters, and bladder surgery	5	0	3	1	1	1	1	0	12
	Sympathectomies	0	2	2	2	0	0	0	0	6
	Appendectomies	1	1	0	1	0	0	0	0	3
	Group B total cases	12	7	10	4	3	4	2	0	42
Total cases Groups A and B		29	27	24	16	25	29	23	7	180

Pre-operative medication. Unsatisfactory pre-operative medication results in undesirable responses during operation. These responses or reactions are: mental anxiety; mild delirium; restlessness; reactions of idiosyncratic or toxic manifestations, as nausea, retching, or vomiting; changes in pulse, blood pressure, thermal changes, and color. Pre-operative medication is an important factor influencing supplementary anesthesia. The 32 remaining supplemented cases are classified under reactions or responses mentioned.

TABLE VI.—COMPLICATIONS IN RELATION TO OPERATION WITH THE RECOMMENDED SOLUTION AND TECHNIQUE

Complications with fatal termination	Group A					Group B					Total Groups A and B
	Gastric surgery	Biliary tract	Large bowel excluding app.	Small bowel	Total Group A	Pelvic organ	Kidney, ureters, and bladder	Sympathectomy	Appendectomy	Total Group B	
Intestinal obstruction				2	2					0	2
Peritonitis	4				4					0	4
Inanition, postoperative	1				1					0	1
Pulmonary abscesses	1				1		1			1	2
Pulmonary embolus					0	1				1	1
Uremia					0		1			1	1
Bronchopneumonia	3				3					0	3
Secondary abdominal abscesses	1		1		2					0	2
Primary lesion (carcinomatosis)	3				3					0	3
Hyperthermia	1				1					0	1
Total expired	14	0	1	2	17	1	2	0	0	3	20
Complications with recovery											
Hemorrhage					0	1	1			2	2
Wound rupture	1				1					0	1
Atelectasis	2				2					0	2
Bronchopneumonia	1				1					0	1
Pulmonary infarct			1		1					0	1
Pyelitis	1		1		2	1				1	3
Peritonitis	1				1					0	1
Intestinal obstruction	1				1					0	1
Postoperative psychosis	1				1					0	1
Distention and vomiting	1		1		2		1			1	3
Thrombocytopenic purpura	1				1					0	1
Thrombophlebitis	1				1					0	1
Total recovered	11	0	3	0	14	2	2	0	0	4	18
Total complications	25	0	4	2	31	3	4	0	0	7	38
Total number of cases	111	10	13	4	138	21	12	6	3	42	180

Remarks: Examination of Table VI reveals the following observations in the 180 cases with recommended solution and technique: (1) 38 patients, or 21 per cent, developed major complications, and 20 of this 38 or 11.1 per cent of the total 180 cases died. (2) 138 patients, or 76.6 per cent, were in group A, and 31 of these or 17.2 per cent of the total 180 developed complications; 17 patients of these 31 terminated fatally, i.e., 9.4 per cent of the total 180 cases. (3) 111 patients of group A's 138 had gastric operations; 25 patients developed complications; 14 patients died. (4) The majority of deaths in the above 14 cases were due to: peritonitis, 4; primary illness, 3; bronchopneumonia, 3. (5) 42 cases, or 23.4 per cent, were in group B, and 7 of these patients or 3.9 per cent of the total 180 developed complications; 3 of these 7 died.

The question of unsatisfactory pre-operative medication is an extremely difficult problem. The opinions of anesthetists as to what constitutes adequate dosage cover a very wide range; the response of the individual to the usually employed drug also varies tremendously. The usual dosage of pre-operative medication employed with nupercaine anesthesia at the Lahey clinic has previously been mentioned. Repeated small doses of morphine and scopolamine frequently have been used with considerable success by some members of the department of anesthesia; others routinely employ the supplementary intravenous barbiturates.

INFLUENCE ON THE CARDIOVASCULAR SYSTEM INDICATED BY BLOOD PRESSURE CHANGES

Compared with the other agents for spinal anesthesia, nupercaine in the recommended

TABLE VII.—COMPLICATIONS OCCURRING IN CASES WITH 1:1000 DILUTION OF NUPERCAINE

Complications with recovery	Group A					Group B					Total Groups A and B
	Gastric surgery	Biliary tract	Large bowel excluding app.	Small bowel	Total Group A	Pelvic organ	Kidney, ureters, and bladder	Sympathectomy	Appendectomy	Total Group B	
Pyelitis			1		1	1	1			2	3
Intestinal obstruction			1		1					0	1
Total cases with complication	0	0	2	0	2	1	1	0	0	2	4
Total number of cases	2	2	8	2	14	15	4	0	5	24	38

Remarks: (1) 14 of 38 cases, or 37 per cent, in group A. (2) 4 patients, or 10.5 per cent, developed complications. These complications were of no serious import; all recovered.

dosage has very little or no depressive effect on the cardiovascular system. Review of our cases demonstrates that when the changes in blood pressure occur they are usually sudden and marked, are associated with nausea and retching, and appear to be initiated by manipulation of and traction on the abdominal contents, chiefly in upper abdominal operations.

For statistical purposes the changes are grouped in 4 classes: Class 1 includes those cases with no change in blood pressure; class 2, a drop of 25 per cent or less of the original systolic pressure taken previous to the spinal injection; class 3, a drop of from 25 to 50 per cent; class 4, a drop of from 50 to 75 per cent of the original systolic pressure. Table V, entitled "The influence of nupercaine on blood pressure," is again divided into groups A and B, non-supplemented and supplemented.

A considerable number of the cases in classes 3 and 4 fall in gastric surgery (compared with the other types of operation). The importance of the traction factor is demonstrated by the marked percentage difference in class 4 of supplemented and non-supplemented cases; 20 per cent of the total in unsupplemented, 11 per cent of the total in supplemented cases, an indication of our previous statement as to the value of supplementary anesthesia for sensation outside the operative field. The large proportion of cases in class 3 among the supplemented cases in gastric operations is chiefly due to the fact that the supplement was not started until after the fall in blood pressure had been initiated. It is our impression that considerably less fall in blood pressure occurs when the supplement is started as soon as resection is decided upon by the surgeon.

In cases of sympathectomy the fall in blood pressure was influenced by the therapeutic effects from the operation rather than any untoward action of the anesthetic agent.

COMPLICATIONS

Complications occurring during anesthesia were rare and but 4 were recorded. They were cases of early sudden unconsciousness, as previously mentioned, when the patient was placed in the initial prone position. Two patients were immediately turned to the supine position and the other 2 received small doses of the previously mentioned pitressin-ephedrine mixture. Recovery was immediate in all, and the course thereafter uneventful.

The source of our data for all postoperative complications is from the progress and discharge notes by members of either the surgical or the medical department. Minor complications might have escaped notation but every major complication occurring during the patient's stay in the hospital was recorded. We have included all listed complications, whether apparently caused by the operation or caused by the anesthesia.

The clearest, most concise and detailed methods of presenting these complications are, first, in relation to operation, second, in relation to risk, and, third, in relation to whether probably due to anesthesia or probably not due to anesthesia. At first glance the incidence of complications to total number of operations appears very high in both groups (Table VI). But one must stop and study the tables: the operations consist of major serious surgery on a group of poorer risk patients than one usually reports.

TABLE VIII.—COMPLICATIONS OCCURRING IN CASES WITH 1:1500 SOLUTION BUT VARIED TECHNIQUE

Complications with fatal termination	Group A					Group B					Total Groups A and B
	Gastric surgery	Biliary tract	Large bowel	Small bowel	Total Group A	Pelvic organ	Kidney, ureters, and bladder	Sympathectomy	Appendectomy or hernia	Total Group B	
Pulmonary embolus	3				3					0	3
Bronchopneumonia	1	1			2					0	2
Gas gangrene		1			1					0	1
Hemorrhage	1				1					0	1
Failure from primary illness		1*			1					0	1
Total deaths	5	3	0	0	8	0	0	0	0	0	8
Complications with recovery											
Intestinal obstruction	1		2		3					0	3
Pyelonephritis	1				1					0	1
Total complications with recovery	2	0	2	0	4	0	0	0	0	0	4
Total cases with complications	7	3	2	0	12	0	0	0	0	0	12
Total number cases with 1:1500 plus other techniques	17	4	7	0	28	5	0	0	0	5	33

*5½-hour operation.
Remarks: (1) 28 of 33 cases, or 85 per cent, were in group A. (2) 12 of 33, or 36.3 per cent, developed complications postoperatively. (3) All the 12 patients were in group A. (4) 8 of these patients, or 24.2 per cent, of the total of 33 patients died from complications.

In considering all complications of nupercaine anesthesia we also include all the cases in which other solutions and technique were used (Tables VII and VIII).

Complications in relation to risk. In Table IX we present the complications in relation to the pre-operatively evaluated grade of risk in those cases in which the recommended solution and technique were employed. Review of Table IX reveals: (1) The morbidity and mortality are progressively increased in the more serious risk cases, as one would anticipate. This increase is marked in the ratio of mortality to morbidity percentages. (2) Due to the limited number of cases in grade 4 the results in this grade are of little statistical value.

Complications in relation to anesthesia. In evaluating the influence of anesthesia as a causative factor in postoperative complications, we divide the complications into two main divisions: (1) those complications probably due to anesthesia, and (2) those complications probably not due to anesthesia. Table X charts this division. All complications when there is a question of causation are grouped as being caused by the anesthesia.

Examination of Table X reveals: (1) 15 cases of 38 or 39.5 per cent of the complications were probably due to anesthesia; (2) of these 15 cases, 7 patients died; (3) 23 cases of 38, or 60.5 per cent, of the complications were not due to anesthesia; (4) of these 23 cases, 13 patients died; (5) peritonitis was the more frequent complication and has the highest mortality; (6) bronchopneumonia is next in frequency and mortality; (7) the incidence of pulmonary emboli and abscesses is higher than one usually encounters; (8) hyperthermia fol-

TABLE IX.—COMPLICATIONS IN RELATION TO RISK WITH RECOMMENDED SOLUTION AND TECHNIQUE

Class of risk	I	II	III	IV	Total
Number of cases of each risk developing complications	3	23	11	1	38
Per cent of cases of each risk developing complications	11.5	21.7	24.4	33.3	
Number of complicated cases with fatal termination	1	11	8	0	20
Per cent of cases with fatal termination					
a. Total cases	4	10	17.5	0	
b. Complicated cases	33	47.8	72.7	0	
Total number of cases in each class	26	106	45	3	180

TABLE X.—COMPLICATIONS IN RELATION TO ANESTHESIA

Complications	Number died	Number recovered	Total number
Complications with recommended solution and technique			
Probably due to anesthesia			
Bronchopneumonia	3	1	4
Distention and vomiting	0	3	3
Atelectasis	0	2	2
Pulmonary embolus	1	1	2
Pulmonary abscess	2	0	2
Hyperthermia	1	0	1
Postoperative psychosis	0	1	1
Total	7	8	15
Probably not due to anesthesia			
Peritonitis	4	1	5
Intestinal obstruction	2	1	3
Primary lesion (carcinomatosis)	3	0	3
Pyelitis	0	3	3
Hemorrhage	0	2	2
Secondary abdominal abscess	2	0	2
Inanition, postoperative	1	0	1
Wound rupture	0	1	1
Uremia	1	0	1
Thrombophlebitis	0	1	1
Thrombocytopenic purpura	0	1	1
Total	13	10	23
Total number with recommended solution and technique	20	18	38
Complications with other methods			
Probably due to anesthesia			
Pulmonary embolus	3	0	3
Bronchopneumonia	2	0	2
Progressive failure (5½ hour operation)	1	0	1
Total	6	0	6
Probably not due to anesthesia			
Intestinal obstruction	0	4	4
Pyelitis	0	3	3
Gas gangrene	1	0	1
Hemorrhage, postoperative	1	0	1
Pyelonephritis	0	1	1
Total	2	8	10
Total number with other methods	8	8	16

lowing nupercaine is occasionally reported in the literature, but in over 251 cases we have encountered but 1 case with the questionable diagnosis of hyperthermia; (9) while there may have been more cases of atelectasis only 2 were of sufficient severity to be noted in the progress notes.

In summing up the incidence of complications in all 5 tables it is evident that the complications are chiefly the result of the operation and are influenced by the grade of risk rather than by the anesthetic agent or method. Without nupercaine spinal anesthesia it would have been extremely unwise to contemplate surgery of this severity on patients of these grades of risk.

SUMMARY AND CONCLUSIONS

1. The ease, simplicity, and accurate determination of anesthetic levels with pontocaine-glucose technique recommend pontocaine as the agent of election in the majority of cases.

2. The use of nupercaine at the Lahey clinic is usually restricted to two general types of operations: (a) those of anticipated prolonged duration, and (b) those of positional importance.

3. (a) The prolonged anesthetic effect from very small doses of nupercaine is highly desirable in prolonged and extensive procedures on poor risk patients; (b) in certain operations of positional importance a hypobaric solution is indicated rather than a hyperbaric solution.

4. Contrasted to the prevalent spinal anesthetic agents nupercaine is derived from a quinine nucleus.

5. The solution recommended is a 1:1500 dilution in 0.5 per cent sodium chloride.

6. As toxicity (W. H. Jones) is chiefly dependent on concentration, the extreme dilution results in very little clinical evidence of toxicity.

7. The technique is Woodbridge's modification of the W. H. Jones technique. The dosage is governed chiefly by the sex and height of the patient.

8. Frequent early skin testing is an important factor in minimizing the occurrence of undesirable degrees of respiratory embarrassment; if this does occur the use of oxygen is a valuable adjunct.

9. In the past, supplementary anesthesia was resorted to after the appearance of untoward effects; at present, supplementary anesthesia (2) is frequently resorted to, early, to suppress these effects.

10. We have found pitressin-ephedrine mixture an excellent vasomotor stimulant to combat undesirable fall in blood pressure.

11. The total number of cases with nupercaine anesthesia is 251; 180 with the recommended solution and technique. These 180 cases we report in detail, the remainder are mentioned in relation to complications.

12. These 180 cases are subdivided into (a) group A or serious risk major operations of anticipated long duration, numbering 138, and (b) group B or operations in which the immediate position of the patient indicates a hypobaric solution.

13. The majority of cases in group A are moderate to decidedly poor grades of risk, and the duration of anesthesia with a minimal depressive effect, characteristic of the nupercaine anesthesia, probably lessens operative hazards in these serious risk patients.

14. Supplementary anesthesia is resorted to not because of an unsatisfactory drug or faulty technique but rather to lessen the technical surgical difficulties and to alleviate mental and physical discomfort to the patient.

15. Nupercaine in the solution and dosage recommended has very little or no depressive effect on the cardiovascular system.

16. Review of Tables VI to X, inclusive, demonstrates that the incidence of complications is chiefly dependent on the type of operation and grade of risk.

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REGIONAL FIBROCYSTIC DISEASE

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VON RECKLINGHAUSEN'S classical description of the pathology of generalized cystic changes in the human skeleton was published in 1891. The various diseases which he described in a single classification are now well differentiated entities. The clinical and pathological changes of localized fibrocystic disease are well understood, but the etiology continues to be a subject for conjecture. Less commonly a type of fibrocystic disease may involve two or more bones and yet be confined to the same skeletal region or extremity. Rarely has this peculiar regional type of the disease been considered as a distinct entity in the description or the classification of the various types of fibrocystic disease.

A complete discussion of the nomenclature of this disease is given by Lichtenstein, who selected the descriptive term "polyostotic fibrous dysplasia." Hodges, Phemister, and Brunschwig, in 1936, first introduced into medical literature the term "regional fibrocystic disease." This appears to be entirely appropriate in a classification using the names "localized" and "generalized fibrocystic disease." "Regional" signifies that the disease is more extensive than "localized," yet that it is definitely limited to a certain portion of the body.

Ten cases, which may be classified under this heading, have been studied in the University of Chicago Clinics. The data which were obtained are summarized in Table I. Roentgenograms of the representative cases have been described in the legends.

ANALYSIS OF STUDY

The age of onset is difficult to determine. There are reasons for believing that in many of the patients the lesions were present in infancy, although the first symptoms or signs may not appear until late in life or not at all.

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In our series of patients the ages at the time of onset of first symptoms of the disease were as follows: Case 1, 4 years; Case 2, 13 years; Case 3, 11 years; Case 4, 34 years; Case 5, 10 years; Case 6, "childhood"; Case 7, 10 years; Case 8, 2 years; Case 9, "no symptoms"; Case 10, 7 years.

Six of our patients were males, 4 were females. This does not confirm the impression of Lichtenstein, who believed the disease was three times more common in females than in males.

Eight of our patients had definite symptoms resulting from the disease during childhood. In one patient the first symptoms appeared after maturity. In Case 9 there were no symptoms referable to his extensive lesions. The lesion in the ilium was noted on a roentgenogram of the abdomen which was made because of a gastro-intestinal complaint.

The bones most commonly involved in the 10 cases studied were the ilium and the femur. The frequency of involvement of the various bones was as follows: femur, 8; ilium, 7; tibia, 5; humerus, 3; ischium, 3; pubis, 2; radius, 2; fibula, 2; first metacarpal, 1.

The distribution of the lesions in this series was as follows: Case 7, humerus, radius, first metacarpal; Case 1, humerus, radius; Case 6, humerus, ilium, ischium, pubis, femur, tibia, fibula; Case 2, ilium, ischium, pubis, femur, tibia; Case 4, ilium, ischium; Case 8, ilium, femur; Case 9, ilium, femur, tibia, fibula; Case 5, femur, tibia; Case 3, femur; Case 10, right and left ilium, right and left femurs, and left tibia.

In some cases there is a monomelic tendency, as pointed out by Freund and Meffert. This is a segmental distribution, with involvement of the humerus, radius, and first metacarpal, but not the ulna or other metacarpals, as in Case 7 (Fig. 5). A similar segmental distribution is sometimes seen in the lower extremity. In Case 5, the femur and tibia were involved, while the fibula was normal. The roentgenograms of

these segmentally involved bones showed large irregular trabeculæ in the fibrocystic areas of the proximal bone, while in the distal bones the cortex was thin and the trabeculæ in the medulla diminished or absent (Fig. 5).

In Case 6, the distribution was unilateral with involvement of the humerus, pelvis, femur, tibia, and fibula (Figs. 2, 3, and 4). The lesion in the humerus, however, was small, circumscribed, and not typical of those commonly found in regional fibrocystic disease. If this lesion alone were found, one might be justified in predicating a diagnosis of neurofibroma involving the bone, as has been described by Brooks and Lehman and by Hodges, Phemister, and Brunschwig. Bilateral involvement without generalized skeletal changes was present in Case 10, while in each of the other 9 patients the lesions were limited to either the right or the left side.

Borderline cases of fibrocystic disease may be difficult to classify. A single bone cyst or localized fibrous lesion is readily recognized as the solitary type of disease. Solitary lesions, however, may be progressive and, starting as a small focus, may eventually include more than one-half of the shaft of one of the long bones. This progressive involvement was noted in Case A (Fig. 10), which we have classified as a solitary rather than a regional type of the disease. The cyst, which was at first a small lesion in the proximal metaphyseal portion of the humerus, became larger as length growth was added from this epiphysis. The new bone formed in the proximal portion of the humerus showed the fibrocystic changes, accounting for the apparent progression of the fibrocystic disease. Since this lesion involved only the portion of the diaphysis which was produced by the proximal epiphyseal plate and was essentially cystic instead of fibrous, it should be classified as a solitary type of fibrocystic disease.

A second atypical case which we include for comparison is that labeled "B" in which there was a solitary lesion in the center of the femoral neck and a second in the shaft, just at the level of the lesser trochanter. These lesions were found at operation to be separate cystic areas and the bone between them was apparently normal.

The etiology of the localized and the regional fibrocystic disease is not known. Pommer thought that small hemorrhages into the bone might give rise to a fibrocystic change with subsequent expansion of the lesion and perhaps cystic degeneration. As pointed out by Freund and Meffert, trauma and hemorrhage are probably not primary etiological factors in the regional form. Although multiple bone hemorrhages may occur in hemophilia, fibrocystic changes have not been observed in individuals suffering from this disease.

Generalized osteitis fibrosa cystica is caused by an adenoma of a parathyroid gland, as was first demonstrated by Mandl, and confirmed at operation or necropsy in several hundred reported cases of this disease. However, one of us (Compere) has previously reported that there is no biochemical evidence that either regional or localized fibrocystic disease is the result of disturbance in the mineral metabolism of the body as a whole. It would not seem logical, in fact, to attribute localized or regional osseous changes to a generalized metabolic process.

Lichtenstein believed that regional fibrocystic disease results from primary congenital factors. This may account for the varied extent of the disease, the occasional segmental distribution, and the fact that it is frequently diagnosed in infancy or childhood and that it persists throughout life. Some primary germ cell injury or defect may best explain all of these variants.

That the localized bone cyst and regional fibrocystic disease are separate entities, although they have many features in common, would appear to be a justifiable conclusion. There is little evidence that the localized lesion may progress to the regional form.

The *symptoms* of regional fibrocystic disease rarely consist of more than a mild aching in the area involved and frequently this discomfort is not noted until after an injury. Pathological fractures are common and malunion, delayed union, and refracture are frequent occurrences. In the extensively involved lower extremity, progressive bowing may occur over a period of years (Case 10). As in Case 9 (Figs. 8 and 9), symptoms of the disease may never appear.

TABLE I.—ANALYSIS OF CASES

Case No. Initials and sex of patient	Birth date Nationality Occupation	Bones involved	Summary of history	Blood Ca. and P. mgm. per cent
1 R. H. Male	Born 1898 American Bookkeeper	Left humerus Left radius	At age 4 years, he sustained a fracture of the left radius and ulna just above the wrist. Fractured the shaft of the left radius at age 12 years, the lower left humerus at age 16, and the lower left humerus by sudden movement of the arm at age 33. First seen here at this time and a diagnosis of fibrocystic disease was made. All fractures healed without complications. At age 41, began to have mild pain in lower radius following mild trauma. Roentgenogram showed marked absorption of lower radius, including large portion of cortex. Biopsy and curettement revealed active young connective tissue. Three months later area almost filled in with new bone.	3–2–32 Ca. 10.6 P. 4.0
2 P. W. Male	Not known	Left femur Left ilium Left pubis Left ischium Left tibia	At about the age of 13 years, after several fractures of the femur, refracture with non-union occurred. The leg was amputated because the nature of the bone involvement was not understood. Four years later, symptoms and signs of infection developed in the left iliac region. Upon incision, green-yellow pus was obtained. The cavity in the ilium was curetted. This patient was treated elsewhere and only the roentgenograms and specimens were obtained for study.	
3 G. P. Female	Born 7-16-13 American Student	Right femur (Figs. 1 and 2)	At age 11 years, patient fell, fracturing the right femur. The leg was splinted with a cast for 3 months. Then a metal plate was applied and later removed after healing occurred. At age 16 years patient had pain in the leg for 1 day and the following day sustained a spontaneous fracture of the femur while walking. She was in a cast for 5½ months, wore a brace for 2 years and was then seen at the University of Chicago Clinics at the age of 19 years. Partial ostectomy of entire femoral shaft was done. One year later patient had pain in the thigh. Roentgenograms showed incomplete fracture. A full thickness tibial transplant was placed across the fracture site. There has been no recurrence of symptoms.	1–26–33 Ca. 10.4 P. 5.5
4 W. O. Male	Born 1877 Irish Fireman	Left ilium Left ischium	At age 34 years patient fell, fracturing left femur, and was disabled for 5 months. Following a fall at the age of 40 years, roentgenograms showed no fracture but revealed fibrocystic disease of the left ilium and ischium. Patient was seen here after a fall, when he was 51 years of age, which caused pain, but no fracture.	
5 M. M. Female	Born 1888 Housewife	Right femur Right tibia	Mild aching in the hip since about 10 years of age and in region of right ankle for 2 years. She was first seen in this clinic when 40 years of age. Roentgenograms revealed fibrocystic disease of the right femur and tibia.	
6 M. B. Female	Born 1897 Librarian	Left humerus Left ischium Left ilium Left pubis Left femur Left tibia Left fibula (Figs. 3, 4, and 5)	During childhood, patient had many fractures of the left femur and tibia. These healed, but there was a residual lateral bowing of the upper femur, with a functional shortening of 4 inches. She was operated upon in another hospital and the right fibula was used as a graft to the femur. The left tibia was curetted and a transplant from the right tibia was inserted. There have been no fractures since operation.	11–14–29 Ca. 12.5 P. 3.8 10–8–34 Ca. 10.0 P. 2.4
7 A. C. Male	Born 1920 American Student	Left humerus Left radius Left first metacarpal (Fig. 6)	When 10 years of age, patient fell, fracturing the left mid-humerus. He was seen here 6 months later and the diaphysis of the humerus was curetted. No recurrence of symptoms.	6–14–30 Ca. 12.1 P. 4.0 11–29–30 Ca. 12.3 P. 6.2 1–10–31 Ca. 11.7 P. 4.6 5–25–34 Ca. 11.1 P. 4.6 Urinary calcium = 221.4 mg. in 24 hours (normal)
8 M. K. Female	Born 1898 Swedish Housewife	Left femur Left ilium (Figs. 7 and 8)	At ages 2½, 7, and 17 years, patient fractured left femur. These fractures healed with moderate lateral bowing of the upper part of the shaft. When 25 years of age, patient began to have attacks of pain in the left hip. She was first seen here in 1931 and after curettement of the fibrous material from the proximal third of the femur, a massive transplant from the tibia was inserted. When last seen, 2 years after the operation, she was symptom-free.	5–9–31 Ca. 11.3 P. 2.6 5–12–31 Ca. 11.7 P. 3.9 5–11–31 B.M.R. −14 −11
9 S. M. Male	Born 1881 American Bookkeeper	Right ilium Right femur Right tibia Right fibula (Figs. 9 and 10)	Lesions were asymptomatic, found incidentally when roentgenographic studies of abdomen were made. Died on 2–27–39 and the lesions of the ilium and femur were examined at autopsy (Fig. 12).	
10 T. L. Male	Born 1887 American Minister	Right ilium Left ilium Right femur Left femur Left tibia	Patient was first examined in the University of Chicago Clinics at the age of 48 years, during routine student health examinations. He had had marked outward bowing of both upper thighs as long as he could remember. Since a fall at the age of 7 years, he had suffered repeated attacks of pain in the left upper thigh. At the age of 17 years, he fell from a horse and sustained a fracture of the right femur in the middle third of the shaft. This fracture healed promptly and he was symptom-free for the next 3 years, when he had mild pain in right upper thigh for few weeks after a misstep. Physical examination revealed bowing of upper femurs and limitations of abduction. He returned 18 months later, complaining of pain in the right thigh. Roentgenograms revealed an umbauzone in the right subtrochanteric region and extensive fibrocystic disease of both ilia, both femurs and the left tibia. The pain subsided after the use of crutches for 4 months. Four years later more bowing present, but umbauzone had healed and he was symptom-free.	2–8–35 Ca. 10.4

TABLE I.—ANALYSIS OF CASES—Continued

Case No. Initials and sex of patient	Birth date Nationality Occupation	Bones involved	Summary of history	Blood Ca. and P. mgm. per cent
*A D. S. Male	Born 6-23-25 American Student	Right humerus (Fig. 11)	Patient fell, sustaining a fracture of his right upper humerus at age of 4 years. Roentgenograms revealed fibrocystic disease. Pain in the arm persisted and roentgenograms 1 year later revealed increased fibrocystic involvement. The cystic lesion was curetted. One year later he fractured through the cystic region. At age 7 years, patient was symptom-free, but roentgenograms revealed progression of the lesion so that it was again curetted. When 8 years of age, fracture again occurred through the cyst and because of further progression, it was again operated upon. At age 10 years, there were sudden symptoms and signs of infection in the region. Partial ostectomy revealed pus from which hemolytic streptococcus was cultured. The wound healed, but 2 years later there was spontaneous drainage. The cyst was opened, the cavity curetted, and the wound again healed. At age 14, roentgenograms revealed almost complete healing and the patient was symptom-free.	1–24–31 Ca. 12.1 P. 3.9 6–21–32 Ca. 10.8 P. 4.9 5–20–33 Ca. 11.0 P. 5.8 6–27–34 Ca. 9.8 P. 5.8
*B E. R. Female	Born 1922	Left femoral neck; left subtrochanteric region.	Patient had pain in the region of the left hip following a fall at age of 12 years. The roentgenograms revealed 2 separate cyst-like areas, one in the femoral neck and the other in the subtrochanteric region. These were opened and curetted. No bacterial growth was obtained from the cultures.	10–15–35 Ca. 9.5 P. 4.3

*These cases included for comparison.

Roentgenograms of regional fibrocystic disease show expansion of the shaft, thinning of the cortex, marked irregularity in the density of varying portions of the shaft, with frequent areas of decreased density which may be trabeculated. On the convex side of some of the bowed long bones, such as the femur, cortical defects, suggesting incomplete fracture and similar to those described as *umbauzones* (6) may be noted (Case 10). Occasionally, most often in the radius or in the tibia, the lesion may present the appearance of extensive atrophy with paper-thin cortices, absent or diminished medullary trabeculation, and a homogeneous appearance of the entire bone without the irregular zones of decreased density and the sclerotic septa. In the young or growing child, the epiphyses themselves are rarely involved. However, in Case 6, both the upper and lower femoral epiphyses show what appears to be a fibrocystic change (Figs. 2 and 4). This epiphyseal involvement may have occurred after closure of the epiphyseal plate had taken place.

Chemical determinations of the blood calcium and phosphorus and other laboratory tests in regional fibrocystic disease are normal. Freund and Meffert and Lichtenstein reported that the phosphatase content of the blood was elevated in their cases. This is true in other non-related conditions in which there is hyperactivity of the bone-forming elements.

The gross pathological changes are similar to those of localized or generalized fibrocystic disease. The cortex may be so thin that it can be cut with a knife, or it may appear grossly normal. The marrow spaces are wide and filled with firm yellow, white, or gray fibrous tissue in which there may be small cavities containing fluid or gelatinous material (Fig. 11a). The cyst-like areas which are noted in the roentgenograms may be found at operation or necropsy to be either true cysts or merely translucent areas which are filled with fibrous tissue.

Microscopically, regional fibrocystic disease can be differentiated from the solitary bone cyst, but not from the *localized*, discrete fibrous lesion (Fig. 11). The marrow and much of the cancellous bone may be found to be replaced with dense fibrous tissue. Throughout the fibrous tissue there are irregular trabeculæ varying from markedly thickened and sclerotic bands to thin, widely separated, atrophic bone. Cement lines and osteoid tissue are commonly present, indicating that bone regeneration is occurring simultaneously with destruction. Most of this bone shows very irregular and abnormal calcification. The truly cystic cavities are usually lined with compact fibrous tissue. In Case 2, a microscopic section of the femur just distal to the site of non-union revealed an area of comparatively acellular fibrous tissue. A small central portion was cystic, and surrounding the cystic area was an irregular wall containing abnormally calcified cartilage. No cartilage was found elsewhere in the tissue examined.

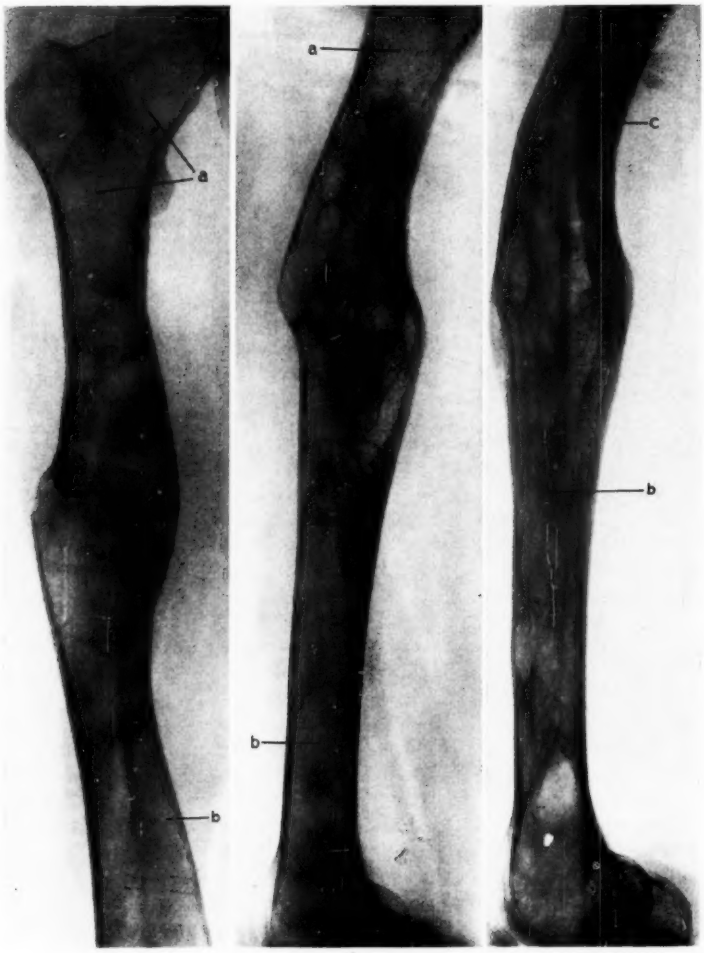


Fig. 1

Fig. 1. Case 3. a, b, This roentgenogram reveals solid union at the site where pathological fractures occurred 8 and 3 years previously. The cortex is thinned irregularly and expanded about the fracture site. The medullary region of the midportion of the shaft shows irregular trabeculation and areas of decreased density. In the subtrochanteric region and extending up to include the inferior half of the neck there is a cyst-like area *a* of decreased density without trabeculæ and surrounded by a sclerotic wall. A similar lesion occupies the medial distal third of the shaft *b*. The femoral head, superior half of the neck, and the greater trochanter appear to be normal. c, A lateral view taken 4 years after a partial ostectomy and 3 years after the insertion of a bone graft *c-b* shows the cortex is heavier, the trabeculations are coarser and more numerous. There has been no recurrence of the fracture.

Fig. 2. Case 6. In the anterior-superior portion of the left ilium *b* and in the supra-acetabular region *c* there are cyst-like areas of decreased density. All of the left pubis and the ischium are composed of similar abnormal bone, with thick, distorted trabeculæ. In the right ilium between the inferior portion of the sacro-iliac joint and the acetabulum *d* there is an area devoid of trabeculæ and surrounded by a sclerotic wall. Multiple pathological fractures occurred in the right subtrochanteric region. These healed with gross deformity. The heavy strut of bone *a* from the neck of the femur to the shaft represents the fibular transplant which prevented subsequent fractures.

Fig. 3. Case 6. There is a cyst-like area *a* in the distal portion of the left humerus which is devoid of trabeculæ and surrounded by a sclerotic wall. The other bones of this extremity are normal.

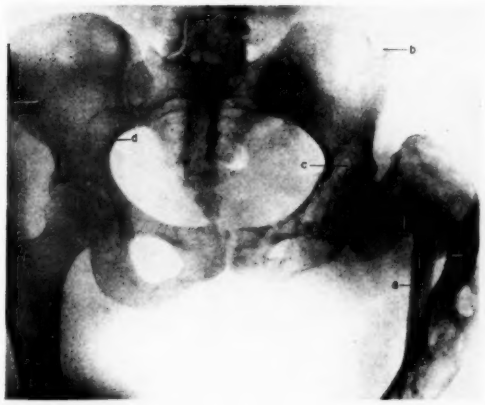


Fig. 2

Fig. 3

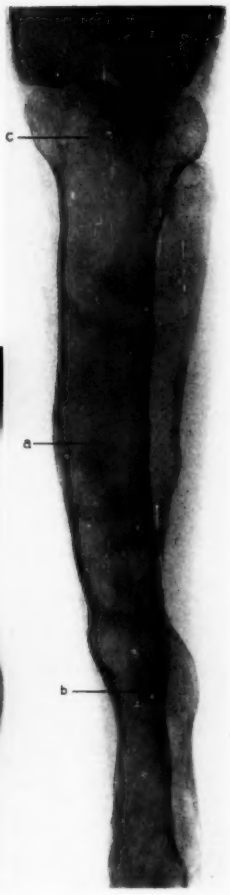


Fig. 4

Fig. 4. Case 6. The fibrocystic changes include the entire left femur, tibia, and fibula. The roentgenograms show irregular expansion of the diaphyses and irregular absorption of the cortices. The medullary regions contain many rather large areas which are devoid of trabeculæ. The medullary bone between these areas is irregular and sclerotic. In the anterior portion of the tibia, crossing the junction of the middle and distal thirds, is a dense bone *a-b* with normal trabecular pattern, representing bone transplant from the normal tibia to this region. One cyst-like area extends into the region of the proximal tibial epiphysis *c*.

(*Legends for Figs. 2 and 3 on opposite page.*)

Fig. 5. Case 7. a, left, The proximal half of diaphysis of the left humerus is expanded. The cortex is thin and the medullary region devoid of trabeculæ. In the distal half of the humerus the cortex is irregularly absorbed but not expanded. The medullary region contains 6 cyst-like areas. The epiphyses are normal. A pathological fracture of the middle of the shaft 5 months earlier has completely healed. An operation was performed and the fibrocystic areas were curetted. Four years later a roentgenogram showed that the fibrous areas had decreased in size and the bone about them was denser. The surgical defect was still present, surrounded by sclerotic bone. b, A frontal view of the forearm shows expansion of the proximal third of the radius *a*. The cortex is thin and trabeculæ are absent. There is slight involvement of the distal portion of the radial diaphysis *b*, but the mid-portion of the radius and the epiphyses appear normal. Somewhat similar changes from normal may be noted in the diaphysis of the first metacarpal *c* and in the base of the first phalanx *d*.

About the cystic areas in Case 9 were loose fibrous tissue and nests of xanthoma or foam cells. Cortex of the ilium showed irregular hypertrophy. Much marrow was a normal hemopoietic type, but in some areas replacement was by fibrous tissue and irregular trabeculæ.

Fig. 6. Case 8. This roentgenogram demonstrates extensive fibrocystic changes of the left ilium and upper femur.

The differential diagnosis of regional fibrocystic disease is not difficult. The generalized fibrocystic disease involves most or all of the bones of the skeleton. The localized type is limited to one bone, although there may be two or more localized lesions in the skeleton of the same individual. True osteomalacia, produced by dietary deficiency or glandular dysfunction, is generalized; it is characterized by extreme atrophy in which cystic changes are uncommon. Neither localized nor regional fibrocystic disease is attended by changes in the calcium and phosphorus content of the blood or in the urinary output of these minerals. Osteitis deformans or Paget's disease may be either local, regional, or relatively generalized. This disease occurs more often in elderly adults. The roentgenographic picture includes a thickened cortex and a narrow medullary region in contradistinction to the changes in regional fibrocystic disease. The calcium and phosphorus studies show a marked retention in contrast to the negative balance in hyperparathyroidism or generalized fibrocystic disease.

A biopsy and microscopic examination may be necessary definitely to exclude malignant or benign neoplastic disease.

The bone involvement in cases of neurofibromatosis may be similar to that of regional

a b c

Fig. 7. Case 8. Extensive fibrocystic disease of femur: a, before and, b, after operation and the reinforcement by means of a heavy tibial bone graft *a-b*, and *c*, 2½ years later. At site of most marked fusiform expansion of the femur *e* the cortex is markedly thinned, there is moderate lateral bowing, and a break in the cortex indicates location of previous infraction *f*. At operation only 2 or 3 small cysts were found, but much of the cancellous and cortical bone had been replaced by firm white fibrous tissue, which was widely excised before graft was inserted. Marked improvement in roentgenographic appearance and strength of bone followed this operation.

fibrocystic disease, but in this condition the brown, or *café-au-lait* skin pigmentation is usually present.

Regional fibrocystic disease is frequently too extensive to attempt surgical eradication. Treatment should be directed to the preservation of function. Recurrent fractures may be prevented by the use of a massive inlay or onlay autogenous bone graft obtained from the tibia. This procedure was carried out with satisfactory results in 3 of the cases which we are reporting (Cases 3, 6, and 8, Figs. 1, 2, and 7). Persistent aching in bones which show fibrocystic changes may be relieved by partial ostectomy and curettage, following which the defect should be filled with bone chips or a full thickness autogenous bone graft. If the symptoms are vague or mild and no fracture impends, operations may not be indicated or justified. In Case 10 pain localized to the region of an *umbauzone* was relieved following the use of crutches for about 4 months.

The immobilization of pathological fractures through fibrocystic areas should be carried out

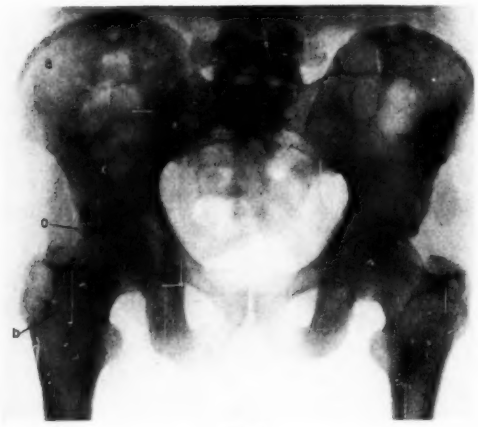


Fig. 8

Fig. 8. Case 9. The entire trabecular pattern of the right ilium is abnormal *a*. Moderate fibrocystic changes are shown in the neck of the right femur *b*. An os acetabulum is present *c*.

Fig. 9. Case 9. a, The diaphysis of the right femur is not expanded or bowed. There is moderate regional endosteal absorption of the cortex. The medullary trabeculæ are wide and irregular with many intervening areas of rarefaction. The distal epiphysis and a small portion of the adjacent diaphysis are normal.

b, The diaphyses of the right tibia and fibula are irregularly expanded. The cortex is thinned. There are at least 6 fibrocystic areas *a* of decreased density in the medulla, each surrounded by sclerotic bone. The roentgenographic changes in the fibula are similar to those present in the tibia.

Fig. 10. Case A. Localized fibrocystic disease showing progression of the lesion. a, left, At age of 5 years the disease involved the upper 4 centimeters of the diaphysis. There was expansion of the shaft, thinning of the cortex, and irregular trabeculations. The epiphysis was normal. b, At the age of 8 years the disease involved more than half the diaphysis, even though there had been several fractures through the area and the lesion had been curetted twice. The upper half of the lesion is expanded, the cortex is thin, and the medullary region has numerous areas of decreased density with wide irregular trabeculæ between them. This type of lesion may be confused with the regional fibrocystic disease.

Fig. 11. Pathological studies in Case 9. a, Photograph of the femur after it was cut longitudinally. The epiphyseal regions of the head, greater trochanter, and condyles appear normal. The upper half and part of the lower half of the medulla are filled with yellow and gray fibrous tissue. The trabeculæ in the fibrous areas are irregular and in some places are very coarse and heavy. The cortex is somewhat sclerotic and in one area, just below the lesser trochanter, it is expanded about a small cavity filled with fibrous tissue. b, Photograph of microscopic section of the upper third of the femur. The epiphyseal regions of the greater trochanter and the head appear normal. Between these regions and the medulla is a sclerotic wall of bone (see in microscopic study c). In the medulla the trabeculæ are irregular and coarse. There are several small cavities in the medulla.

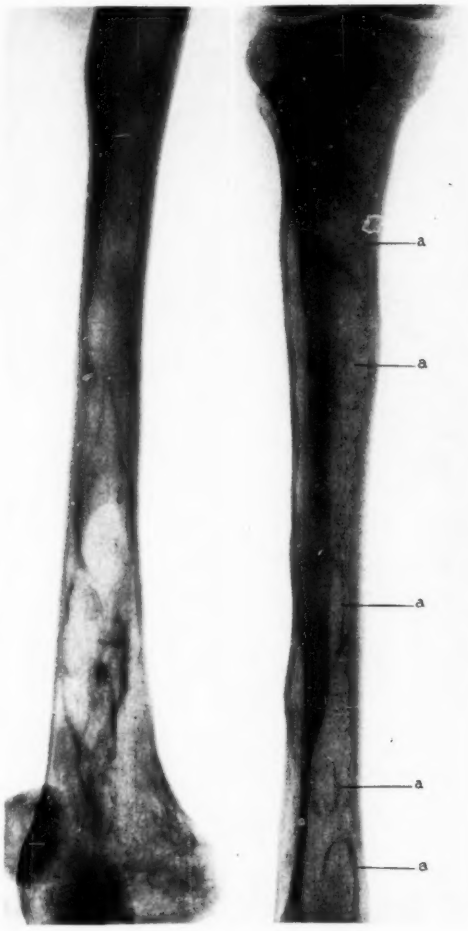


Fig. 9

On microscopic study, the walls of these cavities are seen to be composed of degenerated fibrous tissue. In several regions near these cavities small nests of xanthoma or foam cells were seen. The presence or meaning of these cells is not understood. c, Microscopic study of the wall of bone separating normal marrow and fibrocystic disease. The marrow on the epiphyseal side is normal fatty marrow with occasional collections of hematopoietic cells. The trabeculæ are normal or slightly hypertrophied. The bone on this side of the wall separating the two regions is normal while the bone on the other side is irregularly calcified, containing many cement lines and irregular in form. The marrow is replaced throughout the diseased portion by moderately cellular fibrous tissue. d, High power microscopic study of the fibrocystic disease shows the histology of the fibrous marrow. This is very vascular in some areas. An irregular bony trabecula is shown.

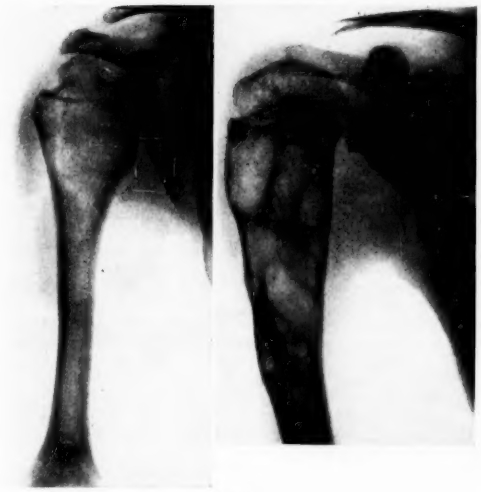
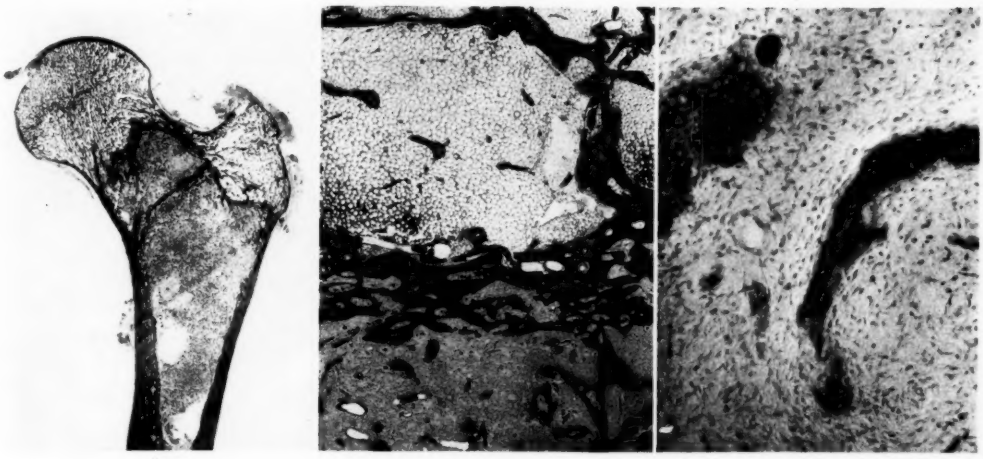


Fig. 10

over a longer period of time than for fractures of normal bone and the return to full functional use should be delayed. There would seem to be no indication for the feeding of inorganic calcium, phosphorus, or other minerals, or of vitamin concentrates to a patient suffering from regional fibrocystic disease. These substances may be abundantly supplied in a well balanced diet.

a

Fig. 11



b c d

Fig. 11

(Legends for Figs. 10 and 11 on opposite page.)

CONCLUSIONS

1. Regional fibrocystic disease is a clinical entity. It is similar to localized fibrocystic disease but the extent of involvement and differences in gross pathology differentiate the two diseases.

2. There is no difference in the sex incidence of regional fibrocystic disease. It is probably congenital in origin.

3. Symptoms usually begin in childhood. Pathological fracture is the most common symptom. Lateral bowing of the upper femur is the most common late deformity. Patients may have the disease over a period of many years without any symptoms being produced by the lesions.

4. Roentgen changes are typical and in most cases the differential diagnosis is readily made. The blood phosphatase level may be elevated, but other known chemical or biological tests are not changed by the disease.

5. Treatment is limited to preservation of function and correction of deformities. Occasionally surgery is indicated for relief of pain.

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STUDIES ON THE ILEOCECAL JUNCTION (ILEOCECUS)

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JUNCTIONS of two hollow viscera are constant sources of study and speculation in respect to their development, structure, and function, and the relationship of these subjects in turn to clinical manifestations. Three such junctions in the gastro-intestinal tract have been known as the cardia, the pylorus, and the ileocecal sphincter, respectively. In keeping with the nature of the first two words, and for brevity, we propose the name, "ileocecus," for the junction of the ileum with the cecum.

EMBRYOLOGIC CONSIDERATIONS

Embryologically, the primordium of the ileocecal junction, the hindgut, is at first a straight tube (2). Later this junction of the ileum and colon forms a right angle. Connections of other parts of the gastro-intestinal tract remain throughout life as either a straight tube or a gradually curving tube. The anlage of the cecum, present in the 7 millimeter embryo, becomes so prominent in the 40 millimeter embryo that the intestinal tube forms a right angle at this point. The caudal portion of the intestine seems to be pushed around to a connection at right angles to the cephalic part of the tube. In early embryonic life, the large intestine is on the left side of the body cavity, with the ileum connecting to it from the right side (3). With subsequent growth, the cecum and colon revolve through a 180 degree arc around the long axis of the bowel, ending with the cecum situated in the right lower quadrant of the abdomen and the ileum connecting from the left. Keibel, basing his assertion on the work of Toldt, claimed that the bending of the vermiform process and cecum upon the colon incorporates the ileum in the angle, thus flattening the distal end of the ileum and producing the superior and inferior labia. The fact that the ileum does not increase in size as rapidly as does the large intestine, thereby exerting a stretching action on the opening of ileum horizontally, seems to us to be a more reasonable explanation of the flat labia frequently seen when the ileocecus is relaxed than the one of Toldt. The appearance of the relaxed ileocecal junction as a papillary eminence in early infancy further tends to substantiate this hypothesis.

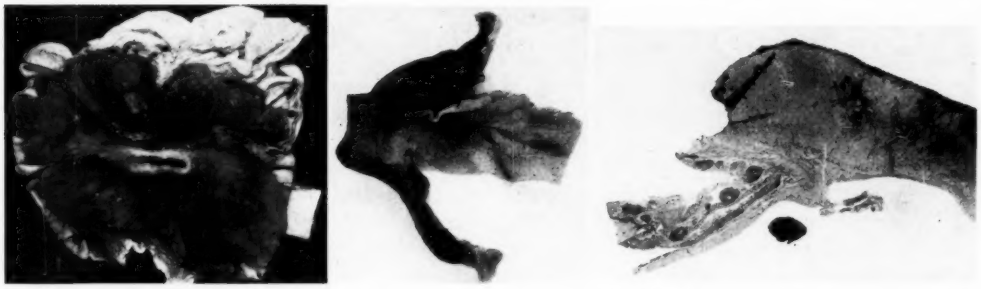
From the Division of Medicine and the Section on Proctology, the Mayo Clinic. A part of the material included here is an abridgment of a thesis submitted by Dr. Harrison R. Wesson to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery. Work done in the Department of Pathologic Anatomy, and on the Intestinal Service, the Mayo Foundation, Rochester, Minnesota.

Dr. Wesson now resides in Montclair, New Jersey.

MUSCULAR STRUCTURE

One of us (Wesson) examined more than 50 human ileocecal junctions microscopically in multiple sections and with the aid of stains. These specimens covered the chronologic range between fetal life and advanced senility. Longitudinal sections were made of each labium. In every instance, the longitudinal muscle fibers were found to enter the labium for a considerable distance. In some instances, the circular muscle was found to be better developed than in others, but in no instance was an extracircular muscle noted, the existence of which in the structure concerned has been claimed by Rutherford.

Fig. 1. Section through the ileocecal labium of a newborn infant, showing the longitudinal muscle extending well into the labium.



a b c

Fig. 2. a, Lymphatic block at the ileocecal junction; b, longitudinal section through the gross specimen shown in a; c, longitudinal section through the ileocecal junction of a newborn infant. The junction was injected with a solution of India ink and gelatin.

In some instances serial sections were made of the entire labium. These sections established the fact that the longitudinal muscle comprises a part of the labium across the entire width of the structure. By means of Lendrum's method, a reconstruction of the ileocecal junction of a full term, stillborn infant was made, which demonstrated that the longitudinal muscle fibers enter the labium from both the ileal and the colonic sides and extend inward almost to the tip of the labium, where there is a union of the two bands of fibers. In places an interlacing of the two longitudinal muscles seems to occur. These facts clearly demonstrate that the outer longitudinal band of the muscularis propria enters the superior and inferior labia of the ileocecal junction, and together with the circular muscle and the muscle of the distal portion of the ileum, may well evolve into an anatomic structure possessing sphincteric action (Fig. 1).

LYMPH AND BLOOD SUPPLY

With a solution of 10 per cent gelatin, blackened with India ink, and with thymol as a preservative, warmed to a thin liquid and kept warm in a warm water bath, and with this solution maintained at a pressure of 100 to 150 millimeters of mercury, 15 specimens of the ileocecal coil taken from unembalmed cadavers were injected successfully in the lymphatic and submucous spaces.

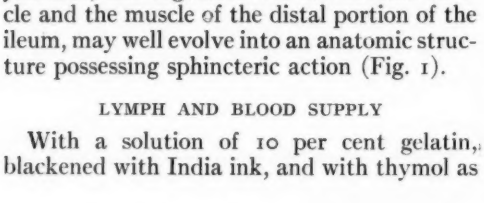


Fig. 3. Longitudinal section of a specimen injected from the ileal side. Notice the solution in the intermuscular spaces.

Many other specimens were injected before methods and results were found to be satisfactory. It was noted that the solution flowed more rapidly when it was injected into the submucous spaces of the colon than when it was injected into the ileal side of the junction. On the side of the colon the solution flowed fairly uniformly up to the tip of the labia, at which point there was a definite block of the solution (Fig. 2a, b, and c).

By a similar procedure, the bowel was injected from the ileal side. The same type of block as was seen in the specimens injected from the side of the colon was noted (Fig. 3). A definite block to the free flow of tissue juices in the submucosa at the ileocecal junction is suggested by the preparations of India ink-gelatin produced in postmortem specimens. The abrupt stoppage of the pigment in the presence of melanosis coli and the frequent limitation of a cancerous growth of the ileocecal junction to the cecal side is in keeping, clinically, with this observation.

The ileocecal artery, a branch of the superior mesenteric artery, furnishes the blood supply for the terminal portion of the ileum, cecum, and lower part of the ascending colon. There are cecal branches which run anteriorly and posteriorly over the cecum, in the groove

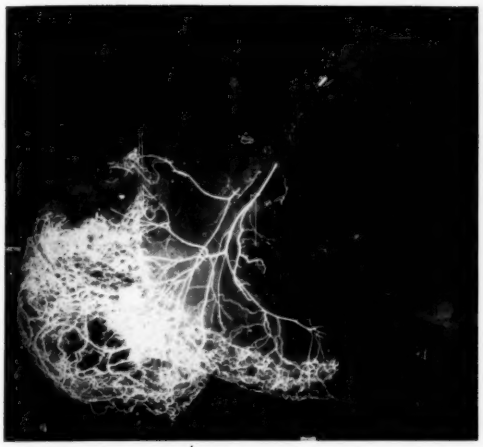


Fig. 4. Roentgenogram of an ileocecus that has been injected with mercury.

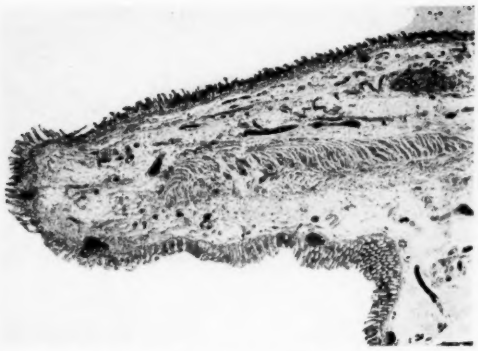


Fig. 5. Longitudinal section of the ileocecal labium after injection of the ileocolic artery, showing submucosal vessels on both sides of the labium.

created by the junction of the ileum and cecum. As these branches cross, they also furnish small subserosal branches which extend medially over the ileum.

Specimens obtained at necropsy, including the proximal third of the ascending colon, the cecum, the terminal 10 centimeters of the ileum and the mesentery of this region which included the ileocecal artery, were collected. By suitable methods the ileocecal artery was injected with a solution of 4 per cent gelatin and India ink. The mesenteric branches of the ileocecal artery, extending medially to supply the ileum, were clamped and then by injecting the artery it was clearly demonstrated that there were subserosal vessels extending medially onto the ileum from the colon. Eventually, even the large ileac vessels filled with the solution, in spite of the fact that the ileac branches of the ileocolic artery were completely occluded (Fig. 4). Just how the anastomosis occurs, whether through free submucosal anastomosis, or intermuscularly, was not demonstrated, but that there is adequate anastomosis in the labium is clear (Fig. 5).

PHYSIOLOGICAL CONSIDERATIONS

The ileocecus seems to prevent the reflux of the content of the large intestine into the ileum (1). Also, it probably prevents too

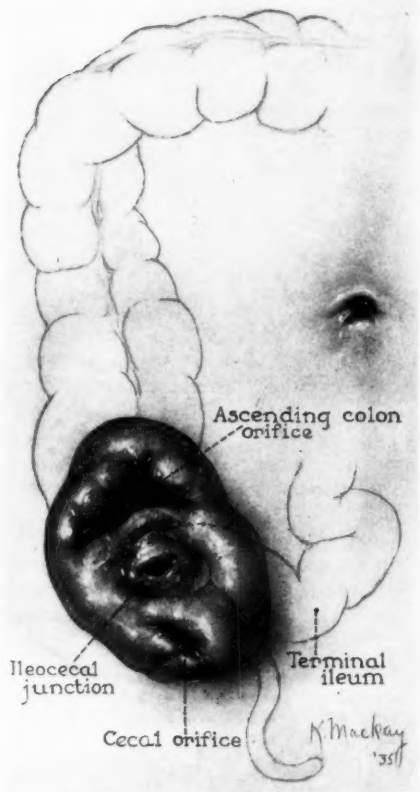


Fig. 6. Schematic drawing of the exposed ileocecus, Case 1.

Fig. 7

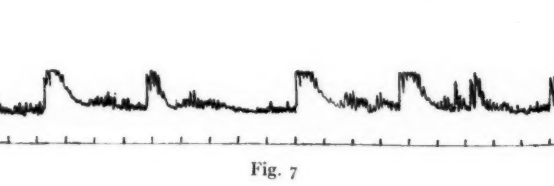


Fig. 8

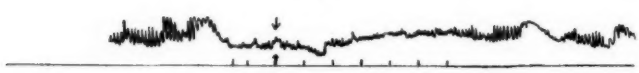


Fig. 9

Fig. 7. Kymographic tracing of the contraction of the ileocecal sphincteric structure and its failure to respond after rapid, repeated stimulations. The initial upstroke is caused by insertion of the finger in the colon for a period of five seconds. One centimeter equals 1 minute in time. Case 1.

Fig. 8. Kymographic tracing illustrating the relaxation of the sphincteric structure following injection of 0.8 milligram of epinephrine intramuscularly, Case 1.

Fig. 9. The effect of injecting 100 milligrams of acetylcholine intramuscularly. Relaxation of the sphincteric structure is followed by contraction, Case 1.

rapid a passage of intestinal content from the ileum into the colon (9). Movements of this region in the intestine are small and slow.

Opportunity to make observations directly on the living human ileocecus seems to be a rare privilege. We have found records of 4 instances in which such observations were made. Macewen, Rutherford, Short, and White, Rainey, Monaghan and Harris have made observations on the human being, in the years 1904, 1914, 1919, and 1934, respectively. They observed an increased activity of the terminal portion of the ileum from the cecal side and of the ileocecus, occasional rhythmic contractions of the terminal portion of the ileum and change in tone of the muscle and relaxation of the ileocecus following the injection of epinephrine.

We wish to record studies on the exposed ileocecus of two women who volunteered to co-operate in the investigation. In both instances, the patients came under our care months after cecostomy had been performed and after the intestine had assumed its normal motility.

REPORT OF CASES

Case 1. The first patient was a woman, aged 55, who had had cecostomy performed elsewhere for an obstruction of the descending colon. Prolapse of the cecum had occurred, so that the structure protruded in the everted position about 5 centimeters above the anterior abdominal wall. The oval mass thus produced measured 10 by 7 by 5 centimeters, and presented three openings: (1) an inferior one into the shallow cecal pouch, (2) a small ileal opening, and (3) a large superior opening leading into the ascending colon (Fig. 6).

The small ileal opening admitted the index finger without causing any pain. The ileocecal muscular structure was relaxed most of the time, especially when the patient was lying quietly in bed. Periods of 30 to 60 minutes would elapse without any activity in the sphincteric structure during which time there would be no passage of ileal content. When the

tissues of the ileocecal junction were relaxed, the structure appeared as a slit-like orifice with its superior and inferior labia, which is similar to the junctions as they are seen at necropsy, but when the musculature contracted, which it did periodically, its shape was a mammillary eminence with an opening in its summit.

The eating of food greatly increased activity in this region and soon ileal content could be seen to appear in small jets. With the onset of any activity in this region, the ileocecus contracted, then gradual relaxation and the passage of the ileal content followed. A small amount of barium suspension was administered to the patient by mouth and it appeared at the ileocecal opening in 4½ hours. When the finger was inserted into the ileal opening, it was gripped by a definite muscular sphincter. This muscular band was situated about 3 centimeters from the dome of the mammillary eminence. White and associates recorded a similar observation.

The insertion of a finger proved to be the best method of stimulating this sphincter-like contraction. Inserting the finger into either the cecal or the colonic orifice produced a similar contraction of the ileocecus. After stimulating the ileocecus to contraction, it was not possible to insert the finger into the contracted ileocecus until it relaxed; this action required from 1 to 2 minutes.

Efforts were made to record some of these contractions. The apparatus used consisted of a rubber balloon, a writing lever on a rubber tambour, and a kymograph. The balloon was made of light rubber and was tied over a hollow glass tubing which had been perforated along its sides and closed distally. There were two cuffs of glass on the tube, one at the closed distal end, the other 5 centimeters away, just above the perforation, which helped to maintain the balloon in its desired position. A mechanical stimulus with the finger in the colon for 5 seconds resulted in an initial abrupt rise of the writing lever, caused by pressure on the balloon by the inserted finger; this was followed by a true record of the contraction of the ileocecus (Fig. 7).

After 4 stimulations in sequence, the response of the ileocecus was much shorter and less effective, suggesting evidence of fatigue. Injection of 0.8 milligram of epinephrine resulted in prompt relaxation of the sphincter-like mechanism; this relaxation was maintained for more than 30 minutes (Fig. 8). Ten milligrams of acetylcholine was injected intramuscularly, resulting in prompt decrease in the tone of the muscular structure, followed in about 2.5 minutes by a gradual increase in the tone (Fig. 9).

Although the patient was entirely co-operative during our investigations, records obtained when other drugs were used were unsatisfactory. For instance, following the injection of physostigmine there was a reaction characterized by sweating, nausea, and vomiting, so that results could not be recorded.

CASE 2. The second patient was also a woman, aged 45, who had had cecostomy performed elsewhere in an attempt to relieve severe ulcerative colitis of the descending colon. All the gross observations made concerning the first patient were substantiated in examining the second, so far as mechanical stimulation, appearance, and motility were concerned. The motor activities of the ileocecus of the second patient have been recorded cinematographically. At the time we encountered her, the main complaint was herniation of the bowel at the cecal stoma, as well as continued bloody rectal discharges.

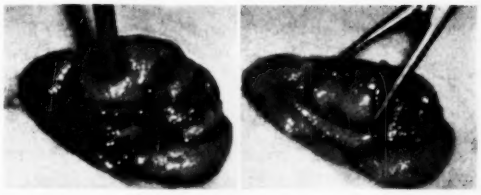


Fig. 10. Left, Sphincteric action in the ileocecus when a rubber catheter is inserted; right, activity of the ileocecus when it is stimulated with a pair of forceps. Case 2.

The size of the prolapse was approximately 12 by 12 by 10 centimeters. The terminal portion of the ileum, with the ileocecal eminence at the distal end, projected at various times from 6 to 10 centimeters above the surface of the abdominal wall. This variation in the degree of projection of the ileocecus and terminal portion of the ileum above the abdominal wall seemingly would be caused by the state of its activity.

If the patient was lying quietly and relaxed and if no stimulus was applied to the region, the terminal portion of the ileum and the ileocecus would appear to be flaccid and relaxed, with a partially patent opening which extended about 6 centimeters above the surface of the abdominal wall. It was extremely fascinating to observe the effect of stimulus such as the attempted insertion of a catheter or a hemostat through the sphincteric structure (Fig. 10, a and b). The terminal portion of the ileum and the sphincter-like mechanism would become turgescent and rise 3 to 4 centimeters above their usual positions in a relaxed state, and the patent ileocecus would become tightly closed; after insertion of the hemostat and a gentle spreading-apart of the blades in order to open the "sphincter," the region would offer some resistance. The normal pink, overlying mucosa would first become a dark red, changing gradually with continued application of the stimulus to a dusky blue-red, with a band of pallor overlying the region of the ileocecus. If the stimulus was not withdrawn, after 30 to 60 seconds the portion would go back into its relaxed state.

Such stimulus caused the patient little pain. The irritability or the response to stimuli also varied considerably, being definitely more marked after food or water was taken into the stomach.

We had hoped to record this interesting phenomenon on the motion picture film which was made just

prior to the patient's going to surgical treatment for the relief of prolapse. She had been fasting for about 16 hours previously, and much to our dismay, the portion refused to perform except very feebly, in spite of all mechanical stimuli. After the pre-operative administration of 1/100 grain (0.00065 gm.) of atropine and ¼ grain (0.016 gm.) of morphine the portion seemed to go into a tetanic state, and little or no response to stimuli occurred.

After the administration of the spinal anesthetic, the ileocecus became entirely relaxed and failed to respond at all. On surgical exploration, the prolapse was found to be so marked that local repair seemed inadvisable, hence the ileocecal coil was resected and ileocolostomy was performed.

SUMMARY

An embryologic review and an anatomical study of the musculature, blood, and lymphatic supply of the ileocecal junction of man have been made. The function of this junction has been studied and clinical observations concerning two human beings have been recorded.

It has been demonstrated that in man, the circular and longitudinal muscles of both the ileum and colon enter the labia of the ileocecal junction comprising a structure with sphincteric action. Stimulation of this region in the human being with resulting contraction and relaxation suggests that its function is concerned with the production of a barrier between the ileum and the colon when such a barrier is needed.

There is a lymphatic block at the tip of the labia of the ileocecal junction. The clinical significance of this has been discussed.

Abundant blood supply and extensive anastomosis of blood vessels in the labia of the ileocecal junction have been demonstrated.

The designation of "ileocecus" has been suggested for the ileocecal junction.

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CHOLEDOCHAL DENERVATION

A New Procedure for the Relief of Biliary Dyskinesia

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PRIMARY operations on the gall bladder, as performed today, are attended by gratifying results in the great majority of cases. This is especially true when the gall bladder contains stones and the remainder of the biliary tract is free of pathological conditions. However, all of us have seen patients with typical biliary colic history and x-ray diagnosis of impaired gall-bladder function without calculi, who show but little gross pathology at the operating table, and in these cases the usual cholecystectomy may not give the desired good result. This group of patients, and a small percentage of those who had real pathological gall bladders, experience a postoperative course most disturbing to the surgeon who sees them in the follow-up clinic, for they persist in having symptoms reminiscent of their pre-operative days.

In recent years the syndrome known as biliary dyskinesia has received considerable attention. Most of the investigators believe that spasm of the sphincter of Oddi is the underlying factor and that such spasm or hypertonicity by itself can give all the symptoms of a biliary colic. Best and Hicken state that physiological evidence indicates that the choledochal duodenal sphincteric mechanism has sufficient contractile force to prevent flow of bile into the duodenum, thereby increasing intraductal pressure. Carter, Greene, and Twiss believe that "the mechanism of biliary dyskinesia does not produce an absolute obstruction of the common duct, but rather a partial and intermittent obstructing influence on the sphincteric mechanism of the common duct." The etiological factors relating to this condition, important though they may be, are not the concern of this report, but rather are we interested in the means of abolishing this spasm.

From the Surgical Service of Dr. Max Danzis, Beth Israel Hospital.

Biliary dyskinesia can be ameliorated by the administration of atropine or nitroglycerine, or by the intraduodenal instillation of magnesium sulphate. These drugs are definite in their action and certainly do give relief, but such relief is frequently only temporary, and recurrences are not prevented. Surgically, this problem has been attacked in a number of ways. In order to avoid the sphincter entirely, the bile has been diverted into the intestinal tract by means of a choledochoduodenostomy. Another method has been the forced dilatation of the papilla of Vater by means of bougies inserted through a choledochostomy. The permanence of this dilatation has been questioned, and the recent experiments of Zollinger suggest that injury to the common duct may occur with subsequent scarring, ultimately resulting in a smaller opening than originally existed. Colp and Doubilet utilized the procedure of endocholedochal sphincterotomy. They devised an instrument called the sphincterotome which they insert into a choledochostomy and cut and remove a segment of the sphincter. In their one case which they reported in May, 1938, the postoperative kymographic records show that the resistance of the sphincter has been markedly diminished by this sphincterotomy.

We believe that there is a genuine need for a procedure which will permanently relax or obliterate the function of the sphincter of Oddi and it occurred to us that an interruption of the nerve supply to the sphincter might accomplish this, if such nerve or nerves could be isolated. The literature does not describe any definite nerve supply of the sphincter. Gray's *Anatomy* states that the nerves to the gall bladder and ducts are derived from the celiac plexus of the sympathetic chain. The branches of the right semilunar ganglion are shown following the course of the hepatic artery, some

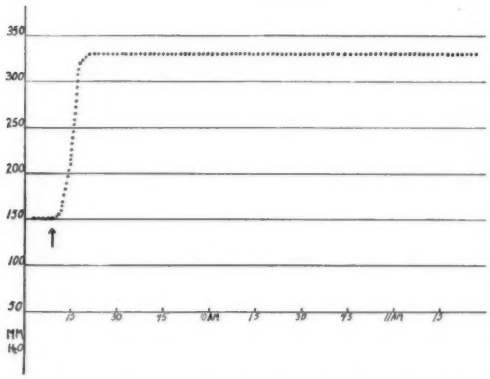

Chart 1. Effect of morphine upon the intraductal pressure in patient with intact choledochal sphincter mechanism. Morphine sulphate, ¼ grain, given subcutaneously, at arrow, causes spasm of sphincter which persists for over 2 hours.

fibers crossing in front of the portal vein, ascending the common duct to the gall bladder; but there is no mention of an innervation of the sphincter. Kuntz, in his book *The Autonomic Nervous System* makes no mention of the nerve supply of the sphincter. Carter states that the gall bladder is under the control of the nervous system—that the vagus is probably motor in character while the splanchnics are inhibitory. They believe that the duodenum and sphincter of Oddi are likewise subject to such nervous regulation, but they make no mention of how the sphincter receives such nerve supply. Oddi described special ganglia in the region of the sphincter and believed that it could be affected reflexly by stimulation of other parts of the gastrointestinal tract. Others (2 and 8) have noted changes in the tone of the sphincter by irritating gastric mucosa or applying drugs directly to the papilla of Vater, but there is no description of the exact nervous mechanism involved. Goldman and Ivy have shown that the hepatic nerves in some way regulate the bile secretion and that section of these nerves is followed by an increase in the flow of bile from the liver, but no mention is made of the effect these nerves have upon the tonus of the sphincter.

In order to satisfy ourselves that there is a distinct nerve which may supply the sphincter, we performed cadaver dissections. The common duct was easily separated from the hepatic artery, and the hepatic plexus of nerves isolated. In following the branches of the hepatic plexus, a nerve was seen running horizontally behind the hepatic artery, approaching the common duct at its distal portion just about where it passes behind the duodenum and directly above the superior margin of the head of the pancreas. Other nerves were seen surrounding the hepatic artery ascending to supply the upper portion of the biliary tract, but the branch just described was the lowest observed to enter the duct. In some cases, pancreatic tissue partially enveloped this nerve. If this nerve actually supplied the sphincter, sectioning of it might result in a paralysis of the sphincter with a marked drop in the resistance offered to the outflow of bile. Having demonstrated to ourselves that the approach to this nerve was surgically possible, we determined to excise a portion of it in the next patient upon whom we had to perform a choledochostomy, in order to investigate the results which might follow such a procedure.

Our patient was a white female, aged 49 years, who had a history of chronic indigestion for years with occasional severe attacks of biliary colic, but no jaundice. X-ray examination showed a chronic cholecystitis. At the operation adhesions were found between the gall bladder and the duodenum, and several small calculi were felt in the ampulla of the gall bladder. Cholecystectomy was performed in the usual manner. No stones were felt in the common duct, but because it was thickened aspiration was done. A gritty, turbid bile was obtained and therefore the common duct was incised and a T tube with very short arms was sutured into the opening. A calibrated pipette filled with saline solution was then attached to the T tube and the resistance of the sphincter of Oddi to this column of fluid was measured. Repeated readings showed the lowest resistance offered by the sphincter to be 125 millimeters. The pipette was then disconnected and by exerting a little traction on the T tube the lower half of the common duct was well outlined. Blunt pointed scissors were used to incise the gastrohepatic omentum between the common duct and the hepatic artery, thus separating the two structures. By retraction of the duct laterally and the artery medially, branches of the hepatic plexus were exposed as they ran behind the hepatic artery. The lowermost nerve exposed entered the common duct directly above the head of the pancreas. This nerve was sectioned at its entrance into the wall of the duct

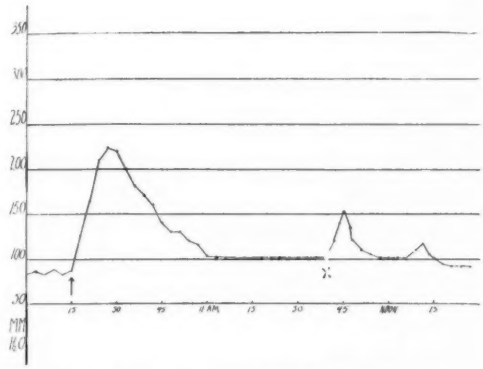

Chart 2. Effect of morphine upon intraductal pressure after denervation of the common duct. Morphine sulphate, ¼ grain, given subcutaneously, at arrow, produces a rise in pressure which is not maintained. The psychic effect of the sight of food is shown at *x*.

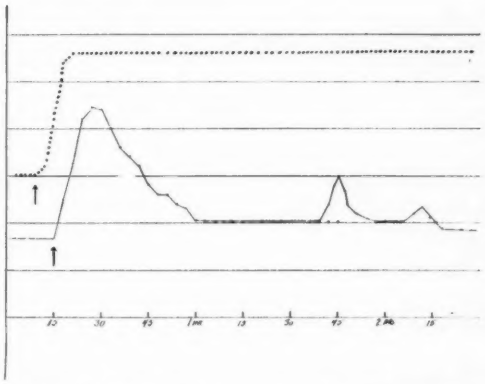

Chart 3. Chart 2 superimposed upon Chart 1, thus illustrating the different effect that morphine has upon the intraductal pressure in the intact choledochal sphincter mechanism (.....) and upon the denervated common duct (——).

and a small portion was excised and sent to the laboratory. (Histological examination showed this to be nerve tissue.) A ligature carrier was then placed behind the common duct from within outward and run up and down for a short distance, in this manner severing some of the nerve supply of the distal half of the duct. Traction on the duct was then released, but no sutures were placed in the gastrohepatic omentum. The pipette was attached to the T tube and measurements were again taken. Repeated readings showed the resistance to be 40 to 50 millimeters lower than it had been prior to the excision of the nerve. If this drop in the resistance is interpreted as being due to a loss of sphincter tone, then the residual intraductal pressure of approximately 80 millimeters must be due to the tonus of the duodenal musculature which surrounds the terminal portion of the duct.

Experiments in the past few years (7) have definitely established the fact that the subcutaneous injection of morphine sulphate increases the intraductal pressure markedly, and the spasm of the sphincter of Oddi, which is the cause of the increased pressure, is maintained for 2 to 3 hours (Chart 1). If, by our procedure, we have impaired the function of the sphincter, the administration of morphine to our patient should have no such effect.

On the tenth postoperative day, therefore, measurements of the intraductal pressure were again taken. This pressure was found to be equal to a column of saline solution 85 millimeters above the level of the common duct, and for about a half hour the variation was no more than 10 millimeters. The patient was then given morphine sulphate, ¼ grain, subcutaneously and within 2½ minutes the intraductal pressure began to rise. This rise was steady and continuous for about 9 minutes when it reached a maximum height of 220 millimeters. This was maintained for about 6 minutes and then a slow but steady fall ensued, occasionally interrupted by slight rises in pressure. Within 45 minutes from the time of the injection the intraductal pressure was about 100 millimeters, almost back to the base line. About 40 minutes later dinner was served to her neighbor and the sight of food caused an immediate rise in pressure to 160 millimeters, and it took almost 10 minutes to return to normal. There was another similar though smaller rise in pressure when she was served her tray. As she ate her food the pressure dropped to the base line and stayed there for the remainder of the experiment (Chart 2).

The significance of this reaction is appreciated when Chart 3 is examined. In the patient with the intact sphincter mechanism morphine causes a precipitate rise in intraductal pressure which is maintained continuously for 2½ hours. In our patient morphine also caused a rise in pressure, which was just as precipitate but not as high, and certainly not maintained for any great length of time. If our contention is correct, that the function of the sphincter has been impaired by interrupting its nerve supply, we must ascribe the rise in pressure entirely to the response of the duodenum to the morphine.

In order to determine the reaction of the duodenum to morphine, we performed the

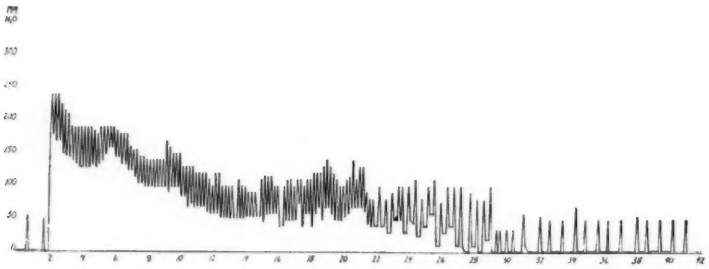

Chart 4. The effect of morphine sulphate upon the duodenum. There is no great increase in the amplitude of contraction, but the rate of contraction and the tonus of the musculature is increased. The effect of morphine is entirely gone after about 30 minutes.

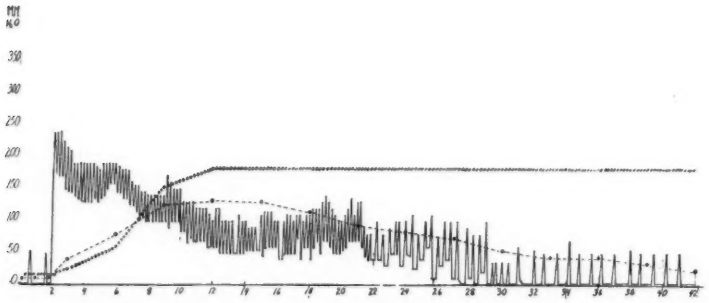

Chart 5. The effect which morphine has upon the intact choledochal sphincter mechanism (.....), the denervated common duct (- - - - -), and the normal duodenum. It is clearly seen that the rise in intraductal pressure in the denervated common duct closely parallels the changes in intraduodenal pressure, whereas in the patient with the intact sphincter mechanism, prolonged spasm is produced.

following experiment on a male adult recuperating from a fractured femur. We attempted this procedure on our patient, but she could not tolerate the tube.

A Miller-Abbott tube was passed and allowed to reach the middle of the duodenum. Its position in the duodenum was checked by the fluoroscope, the balloon was inflated with 25 cubic centimeters of air and the open end of the tube was attached to a water manometer. The sudden inflation of the tube stimulated marked contractions of the duodenum for a few minutes, but thereafter the duodenum became quiescent, contracting about 2 times per minute. Morphine sulphate, ¼ grain, was then given subcutaneously. Within 2 minutes the duodenum began to react and the intraduodenal pressure forced the water in the manometer to rise almost 250 millimeters (Chart 4). However, there was no spasm of the duodenal musculature, but repeated alternating contractions and relaxations, about 6 per minute. This high intraduodenal pressure was not maintained very long, and after a few minutes a slow, steady fall ensued. About 20 minutes later the number of contractions per minute decreased as did the pressure, and after 38 minutes the effect of the morphine appeared to have disappeared entirely.

The important thing to note in this experiment is that for about 8 to 10 minutes the tone of the duodenal musculature remained increased, so that the lowest intraduodenal pressure recorded was 100 to 150 millimeters above the base line. Thereafter the tonus gradually lessened, until it reached the base line about 30 minutes after the administration of morphine, and remained so for the duration of the experiment. This procedure was repeated upon another normal individual, and an approximately similar curve was obtained.

Chart 5 shows the effect of morphine sulphate on the intact choledochal sphincter mechanism, the denervated sphincter mech-

anism, and the duodenum. It is readily seen that when the sphincter is deprived of its innervation, it apparently has no power to respond to morphine, and the rise in intraductal pressure is probably the direct result of the active duodenal musculature.

SUMMARY AND CONCLUSIONS

In presenting this report we are only too well aware of the fact that the result obtained in 1 case is not positive confirmation of the value of any new procedure. However, since the findings were consistent with our theory it seemed well to publish our observations.

1. The pressure within the common duct is partially controlled by the tonus of the duodenum, but the sphincter of Oddi apparently is capable of functioning independently.

2. Morphine sulphate appears to affect the musculature of the duodenum differently than it does the muscle of the sphincter.

3. The possibility should be entertained, therefore, that denervation of the common duct, or excision of the lowermost nerves supplying the duct, may affect the function of the sphincter, thereby relieving biliary dyskinesia.

At this time it may be a little premature, but if further experiments bear out these facts, we offer the suggestion that perhaps this procedure should not be limited to the occasional case of true biliary dyskinesia, but should be carried out, whenever technically possible, in all cholecystectomies, so that some of the unpleasant postoperative complaints may be avoided.

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CANCER OF THE OVARY

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TWO similar articles have been previously written by the author on cancer of the ovary; one was published in the *Southern Medical Journal* (4) for February, 1937, and reviewed the cases at the Massachusetts General Hospital from 1901 to 1931; the second, in the *New England Journal of Medicine* for March 1939 (5), which carried the review through to 1933. This report brings the series through June, 1934, a period of 34 years. The outlook for patients with ovarian cancer is very poor, and for that reason it seems wise to emphasize to surgeons the desirability of earlier diagnosis and more radical treatment. Lynch's paper and the author's first report published at about the same time, give results nearly alike. It is obvious that as the Massachusetts General Hospital series increases in size the prognosis of cancer of the ovary does not improve. In the first series 20 patients were living out of 135, about 14.8 per cent. In the second series there were 24 living out of 147, or 16 per cent; and in the third series (that is, the present series) 25 patients are living out of 154, or 15.5 per cent. The results are discouraging and are worse than most reports on groups of other types of cancer. Carcinoma of the body of the uterus, carcinoma of the cervix, and carcinoma of the breasts all do better. Even carcinoma of the vulva has a better prognosis than carcinoma of the ovary. There is no doubt that if all patients that had any suspicion of a tumor of the ovary were operated upon immediately, if peritoneoscopy were employed for diagnosis, and if pelvic examination could be more accurate, early diagnosis and early operation would markedly improve the end-results.

MATERIAL

This study is a survey of 154 patients who have been seen and operated upon at the Massachusetts General Hospital from 1901 through June, 1934. All ovarian tumors and papillary cysts, not only malignant ones, were grouped together; all microscopic slides were reviewed by the author; and all benign lesions were discarded. It was necessary to ask Dr. Tracy B. Mallory, our hospital pathologist, to settle the question of malignancy or benignancy on numerous occasions, especially in the group of papillary cysts. All odd tumors were excluded from this series; that is, all granulosal cell tumors, Brenner tumors, arrhenoblastomas, dysgerminomas, Krukenberg tumors, teratomas, etc., were discarded. Frequently it was a great question what sort of a tumor a particular slide represented, and if there was any suspicion that it was of the endocrine type, it was excluded from the series. No metastatic lesions in the ovary from the uterus, the cervix, or the intestinal tract were included. All Krukenberg tumors were omitted. If a given biopsy specimen from a small area removed from the abdominal cavity, peritoneum, or omentum looked like ovarian tissue to the pathologist but the surgeon could not definitely state its origin the case was discarded. If there was generalized abdominal carcinomatosis but it did not seem of definite ovarian origin to the surgeon the case was excluded. This is not a very large group of cases, but by its exclusion of benign types of carcinoma—such as the highly specialized endocrine type—and metastatic lesions, it is a true group of primary epithelial carcinomas. If a tumor, previously considered microscopically malignant, did not seem so to the reviewers and the patient was still living, the case was excluded. Knowledge of the patient's history, the operative findings, end-result, and the microscopic study of each tumor was the aim of the author. This should be essential in all reports of malignant disease. The hospital record room files are not sufficient in themselves. The microscopic slide must be reviewed, and if it is lost, the case should be excluded from any report. Misinterpretation in the laboratory without clinical knowledge is easy. The slide must be reviewed along with the history, operative findings, and the end-results. There were certain tumors of the pseudo-

mucinous type with generalized peritoneal implantations. If implantations they are not due to lymphatic extension but are attached to the peritoneal surface by organized granulation tissue, as demonstrated by Dr. John Sampson some years ago. These tumors, if the patient were alive more than 5 years, and if the tumor did not appear to be malignant microscopically, were excluded from this group. Dermoid cysts and teratomas develop in the ovary; from an epithelial cell in such an embryonal development a malignant ovarian tumor may arise. If there are any areas in a tumor suggesting dermoid cyst or teratoma it cannot be classified as a primary epithelial growth of the ovary. Care must be taken to cut numerous sections of all ovarian tumors to exclude its origin from a dermoid or from a teratoma. Carcinomas arising in either act differently from primary epithelial carcinomas of the ovary. Sarcomas develop in the connective tissue of the ovary and must be excluded. There is no doubt that with increasing knowledge there will be found tumors of specialized function in the group of tumors analyzed here. As functioning tumors are less malignant they will probably be found among the survivors.

EMBRYOLOGY OF THE OVARY

Because so many tumors of the ovary are different in their histological characteristics, and because it is obvious that many are embryonic in their type, it is essential to present a short description of the embryology of this organ. The ovary arises as a mass of mesenchyme on the back wall of the abdominal cavity of the embryo. Epithelium from the pelvic or celomic epithelium surrounds this mass. The ova are believed to arise from this surrounding epithelium in one theory and in another from the hind gut, and migrate into the mass. The connective tissue surrounding the ova becomes highly specialized and is the source of the granulosal and thecal cells of the follicles. Therefore, in the depth of the embryonal ovary and arising from connective tissue, are structures that can and do look like epithelial tissue; thus the lining of follicle cysts which arise from granulosal cells is certainly epithelial in its appearance, yet the origin is not epithelial. It is possible that the primordial ova present in the young ovary are not the ones that develop into mature ones. It is thought in some research departments that ova can originate from the epithelial covering of the ovary in adult life.

Some consider the very early gonad neither ovarian nor testicular but that its development depends upon whether or not its germ cells are spermatazoa or ova. It is conceivable therefore that certain cells that might have been testicular are present in the ovary even without spermatazoa; and if so, are the origin of the male endocrine tumors. The young gonad has also been considered as primarily testicular and later ovarian tissue with ova grows around and into it. The testicular tissue then atrophies and the gonad becomes an ovary. This is another source of Leydig and Sertoli cells.

The adrenal gland and the kidneys develop in close proximity to the ovary and hypernephroma of the ovary has been described. Schiller has recently demonstrated a new tumor of the ovary, the so called "mesonephroma"; its tissues look very like renal parenchyme. Thus the sources of the special tumors that are seen in the ovary are quite obvious—the granulosal cell tumor, the thecal cell tumor, the lutein tumor, the arrhenoblastoma, the testicular tubular adenoma, tumors suggesting Leydig cells, and so forth.

TYPES OF TUMORS: GROSS AND HISTOLOGICAL

The tumors were of all sorts: large, small, papillary, smooth walled, cystic, solid, solid and cystic, white, yellow, hemorrhagic, etc. Except for the pseudomucinous tumor there is no way of predicting the microscopic type from its appearance. Histologically two definite types were made out; one, the pseudomucinous tumor which is obvious to all, with its high columnar cells full of pseudomucin; the other, which we call the endometrial type, resembles carcinoma of the endometrium. This tumor is not difficult to differentiate. There is yet another and larger group which we designate "unclassified," without characteristic cell type. Some are clear celled, slightly resembling lutein cells or the cells of the hypernephroma. Others tend toward

squamous epithelium. Still others are like carcinoma simplex. Any tumor that was not of a pseudomucinous type or an endometrial type was placed in the unclassified group. Ovarian tumors grow in different forms. There was the true solid tumor, the solid tumor with necrotic areas in it; and the solid tumor with definite epithelial lined cystic areas in it, papillary and not papillary. There was also the definite papillary cystadenoma with small or large papillary projections inside or outside the tumor or both. It was decided to divide the tumors into two groups, solid and papillary cyst adenomas. (In the first two papers from this clinic they were divided into three groups: solid tumors, or the solid tumors with cystic areas in them; a group of malignant papillary cystadenomas that had adenocarcinoma, or tumor resembling adenocarcinoma in its walls; and malignant papillary cystadenomas.) In this paper the last two groups will be combined into one—the malignant papillary cystadenoma. In the gross a tumor might appear solid with cystic areas in it and papillary processes in the cyst. Microscopically such tumors may have solid cords of epithelium in them but if papillary adenocarcinoma predominates microscopically it will be called a malignant papillary cystadenoma. The true solid carcinoma of the ovary is usually solid carcinoma plus stroma, and the cystic areas in it are those of degeneration and necrosis. The endometrial type of tumor is interesting. There is no reason why there should not be an endometrial tumor of the ovary, for the epithelial covering of the ovary arises from the celomic epithelium. As the celomic epithelium is the source of the muellerian epithelium that produces the endometrium, endometrial cancer should and does occur. Thus it is not unusual to find tumors suggesting muellerian epithelium in the ovary.

The criteria of malignancy used were atypicality of cells, mitotic activity, invasion of the walls, undifferentiation and evidence of more progressive and invasive growth than is seen in the benign papillary cystadenoma. After microscopic study there was no doubt about the diagnosis of malignancy in any of these cases. The end-results usually confirmed the microscopic findings. When a patient dies of her tumor there is very little doubt of its malignant nature.

ENTIRELY SOLID, AND SOLID PLUS CYSTIC CARCINOMA OF THE OVARY

This group is by far the most serious. About one-fourth are inoperable and the symptoms are of short duration. Some of the tumors have cystic areas in them but they are usually due to necrosis. (If there were cystic epithelial areas in a solid tumor and if the tumor in such a cyst microscopically was papillary adenocarcinoma it was called a malignant papillary cystadenoma.) The solid tumors were of various sizes, from small to large. Very frequently the tumor was adherent in the pelvis or the cancer had grown to the peritoneal surfaces and become adherent to the walls of the pelvis. The gross pathology of these solid tumors may be very similar, but the histology is rarely the same. They grow as medullary, squamous, or adenocarcinoma. Its cell type may be pseudomucinous, endometrial, or unclassified; the great majority being unclassified. The study of these tumors has made such an impression upon us that if in the future there is any question of an ovarian tumor in any patient, or if the ovary is hard or unusual, the patient will either be peritoneoscoped or operated upon. It is inexcusable to observe and wait because the prognosis is so very bad. In patients in the menopause age, let us say the age of 45, it is the intention of the author to be radical in the treatment of ovaries in the future. They will be removed unless there is a specific request to leave them. These tumors may be accompanied by abnormal uterine bleeding either before or after the menopause. They can be responsible for an estrin phase in the endometrium, because some of their epithelium secretes estrin. In this series 44.4 per cent of the tumors were bilateral and only 9.3 per cent are living. Therefore radical surgery should be the treatment. Both tubes, both ovaries, the uterus and cervix should be removed if possible. Even if there is no evidence of tumor in the other ovary it should be removed along with the uterus and cervix. No attempt should ever be made to conserve the opposite ovary in a patient who has a

solid epithelial tumor of the ovary. In 22.2 per cent rupture of the tumor occurred before removal and 12.5 per cent lived, a better result than the 9.7 per cent survival of all solid tumors; nevertheless rupture should be avoided. These tumors metastasize far and wide, to the umbilicus, the axilla, the bone, etc. Each patient should be seen regularly for follow-up to determine whether or not she is free of her disease. X-ray treatment is unquestionably of value in prolonging life, but up to the present time we have not satisfied ourselves that it has ever cured. There can be no doubt of the value of peritoneoscopy in this group of patients, and it must be used more frequently in diagnosing these tumors.

MALIGNANT PAPILLARY CYSTADENOMA

In the 2 previous papers an attempt was made to separate these cases into those with and without areas of adenocarcinoma in the walls. There is no need for this division. These tumors are cystic and papillary. They may have large masses of papillary tissue or they may have only small areas. There may be penetration of the wall of the cyst, or the papillary areas may be entirely within the cyst itself. They are frequently adherent and may become widespread throughout the peritoneal cavity. The omentum may occasionally be full of tumor. They metastasize far and wide, as do the solid tumors. Because they are papillary, which means slower growth, and because fewer of them become densely adherent or break through the wall of the cyst the results are better than in the solid tumor. Often surgeons remove a cyst of the ovary and take out but one ovary and do nothing more to the patient, and then later find that the laboratory reports the tumor as carcinoma. If this has been done and the tumor is a carcinoma it is best to re-operate upon the patient and remove the other ovary, the uterus, and the cervix. Because these tumors are so frequently bilateral, 32.9 per cent, it is easy to conceive that the other ovary may develop a malignant tumor. It ought to be removed. It is essential that an ovarian tumor should be opened and looked at by the surgeon, and a pathologist should view it if possible before the abdomen is closed. If it is malignant further surgery should be undertaken. It is often customary for surgeons operating upon patients with large cysts of the ovary to remove the fluid with a trocar before excising them. The results in this series show that those cysts that have been ruptured or have had a trocar used upon them, 25.6 per cent, do better than those that haven't—28.5 per cent as against 21.9 per cent. Nevertheless it is the feeling of the author that small areas of tumor tissue can be spilled and therefore it is not advisable. It must be safer to remove the cyst whole, without spilling, than to spill fluid with pieces of carcinoma into the abdomen. Certainly great care is exercised not to spill the cells of other tumors and there is no reason why this group should be chosen as one in which it does no harm to use a trocar. If a big incision is necessary it should be made, but tapping should not be done. Hodenpyl's theory, advocated years ago, for the treatment of carcinoma with ascitic fluid from patients suffering with malignant disease may be the explanation of the survival of more patients who had spontaneously ruptured tumors or trocared tumors, but nevertheless it does not seem safe to the author to do it deliberately. If, however, one does spill the fluid of a cyst or does operate upon one that is ruptured it does not mean that that particular patient will not have a good prognosis.

Between these two groups there is a great difference in the prognosis, the prognosis of the solid tumor being extremely bad, and that of the malignant papillary cystadenoma being about the same as other types of malignant disease.

SYMPTOMS AND DIAGNOSIS

The symptoms of patients with solid carcinoma of the ovary and of malignant papillary cystadenoma are about the same. Ovarian cancer often gives no symptoms until it is well advanced. Frequently increasing size of the abdomen due to the tumor is considered increasing weight and heaviness due to the age of the patient. There is often a sense of vaginal discomfort and pressure. Occasionally there are slight gastro-intestinal symptoms. Later on the symptoms are those of

loss of weight and urinary difficulty. Ascites is not uncommon. Pain is the commonest symptom; 68 per cent of the solid carcinomas and 65 per cent of the cystic tumors complained of this symptom. About 50 per cent of both groups complained of abdominal swelling. Loss of weight was noticed in about two-fifths of the cystic tumors and one-third of the solid tumors. Urinary symptoms were not uncommon, being present in 41 per cent of the cystic tumors and 25 per cent of the solid ones. Ascites does not necessarily mean a hopeless prognosis, for even simple cysts and fibroids can be accompanied by ascites. Fluid in the abdomen and fluid in the chest in the presence of an ovarian tumor may not mean hopeless malignancy. In a paper published by the author in the *Annals of Surgery* (6) 15 cases of fibroma of the ovary (a simple benign tumor) have been shown to be accompanied by fluid in the abdomen and fluid in the chest. Therefore it behooves us to be ready to operate upon patients who have tumors of the ovary with fluid in the abdomen and chest and to settle whether or not the tumor may be a simple fibroma rather than a malignant lesion. It has been reported that benign cysts and fibroids may be accompanied by fluid in the chest as well as in the abdomen. About one-half of the patients are in the decades 30 to 40, and 40 to 50. There are more young patients in the malignant papillary cystadenoma group than in the solid carcinoma group. The fertility in married women in both the solid and cystic tumors is approximately the same—60 and 63 per cent. This is a low incidence of fertility as 90 per cent is usually given as the normal incidence of fertility (7). Because of the lack of fertility in this group of patients it is necessary to consider the possibility of there being some congenital defect of the ovary. If some congenital developmental abnormality were present there should be an increased chance for growth of left-over cells and hence the production of abnormal growth. About 27 to 30 per cent of the group menstruated regularly and normally. Over 50 per cent had the menopause, while about 25 to 30 per cent gave a history of abnormal bleeding. Their abnormal bleeding is probably due to the fact that many of these tumors secrete estrin and therefore activate the endometrium. Not all active endometrium following the menopause indicates the presence of a granulosal cell tumor. It is the feeling of the author that some of the patients that have small papillary implantations in the omentum and the peritoneum who are cured by removal of their ovarian tumor may be of this type; that is, the tumor may be endometrial, and as estrin, which may be present in the ovarian tumor, causes a growth of the endometrium it perhaps causes a growth of the implanted nodule. As estrin is a growth producer it may be responsible for the activity of these bits of tumor. This is another reason for removing both ovaries and stopping wherever possible all estrin production. It is correct to assume that some estrin may be produced by the tumor because the tumor has its origin from cells which make up the ovary and certainly some of these can produce estrin.

MISCELLANEOUS STUDIES

There were a number of inoperable tumors in this series. In these patients an exploration was carried out, a specimen removed, the ovary observed and a diagnosis made as to whether or not the tumor arose in the ovary. In about one-quarter of the solid tumors and in one-tenth of the cystic group this was all that could be done. It is interesting to note that in the group treated with x-ray after operation, there were about the same number of inoperable cases as in the group who did not have x-ray therapy. There were more patients in the solid group with a short history from onset to operation, and more died in the first year after operation, showing that this type of tumor is really different from the cystic type. In this series the survival rate of patients with bilateral tumors of the solid type was only very slightly below that for the entire group and was better in the cystic groups. There is doubt that those with bilateral tumors have a worse prognosis than those with unilateral tumors. Because of the frequency of bilateral tumors, it is difficult to believe that the surgeons in our hospital removed only one ovary in as many as 20.8 per cent of the patients with solid malignant

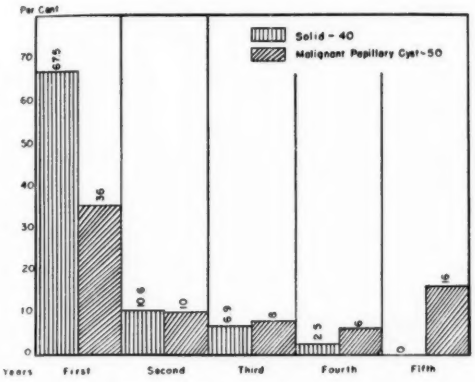

Chart 1. Non-radiated cases.

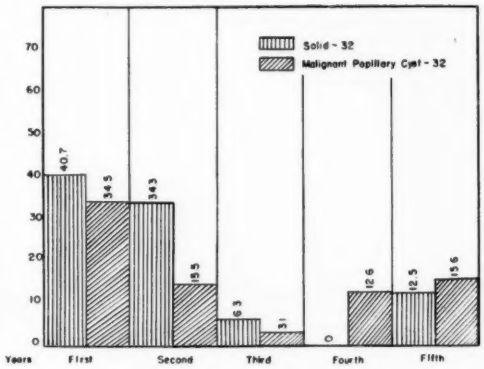

Chart 2. Radiated cases.

tumors, and 22.2 per cent in those with malignant papillary cystadenomas. In spite of the knowledge that so many of these tumors are bilateral, we did not take advantage of our knowledge. In the solid tumors unilateral oophorectomy cured but 6.6 per cent; and in the malignant papillary cyst adenomas, only 16.8 per cent. These curability rates are below the survival rate for either group as a whole. The results of bilateral oophorectomy are better in both groups; the solid group showing a survival rate of 11.4 per cent, and the cystic group, 28.1 per cent. It is also of interest to note that only 6 per cent of the patients in the cystic group had a tumor appear later in the other ovary, while this occurred in none of the solid group. As all cases have been followed carefully for some time this fact is certainly interesting. It may be that we were fortunate; certainly we have not been wise, but from now on I feel sure there will be fewer and fewer times in our hospital that unilateral oophorectomy will be done for carcinoma. Because uterine involvement is so serious the removal of the ovary, uterus, and cervix is best if possible. The presence of adhesions was of serious consequence in the solid group, the results being poorer than those for the whole group. Uterine involvement was very serious as no patient survived 5 years. Postoperative mortality was surprisingly low. Realizing that a large group of these patients were inoperable, 23.6 per cent of the solid group and 10.9 per cent of the cystic group, and realizing that many were operated upon and a desperate attempt was made to remove the pelvic organs it is surprising to find a mortality of only 12.5 per cent in the solid and 3.6 per cent in the cystic group. Figures showing the rate of death following operation are of interest: 55.5 per cent of the solid group died within 1 year and 35.2 per cent of the malignant papillary cystadenomas. These figures point to the very serious consideration that must be given to solid tumors of the ovary of the epithelial type.

TREATMENT

The required treatment of all groups is operative. An accurate diagnosis cannot be made without surgery. Operation should be advised early and insisted upon. Peritoneoscopy should prove of great value in making the diagnosis. It should be the duty of every clinic to have some one familiar with peritoneoscopy, as this should be our greatest help in diagnosing this condition. Any doubtful pelvic examination should be checked by peritoneoscopy or else operation itself should be carried out. The operation should be radical. Whenever possible both tubes, both ovaries, the uterus and the cervix should be removed. It is a good rule, in all ovarian cancers to remove as much tumor as possible and all the pelvic genital organs if the patient's condition will permit. A total hysterectomy is done because the tumors

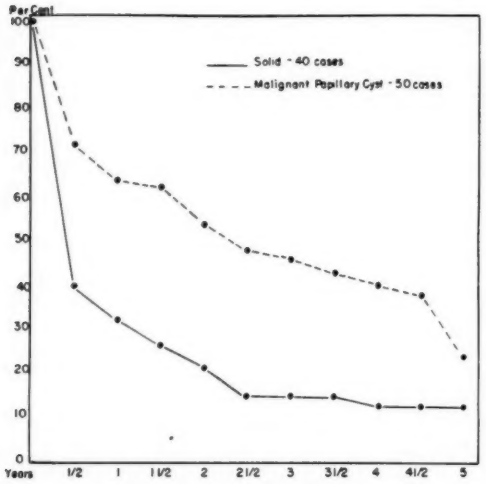

Chart 3. Non-radiated cases.

sometimes metastasize to the uterus, and if they do the chain of lymphatics from the uterus to the cervix may allow further extension of growth. Certain schools advise leaving the uterus behind so it can be used as a locus for radium therapy. Inasmuch as surgery is the best means of treatment and because the new x-ray apparatus can deliver a lethal dosage into the pelvis it is safer to remove the uterus than to leave it for subsequent radium treatment. It cannot be too frequently brought to the attention of surgeons that it is essential to open any tumor that is removed before the abdomen is closed. If papillary processes are found on the outside of a cyst it is best to adopt radical surgery and remove all the pelvic organs, no matter what the age of the patient. If papillary projections are found within a freely movable tumor and the patient is young and wants children conservation is justifiable. In such cases it is important that the patient be seen at least every 6 months for 5 years or more because if a neoplasm can develop in one ovary the same embryonic background is probably present in the other and a tumor may develop in it. In the proper management in malignant lesions of the ovary radical surgery is the rule and conservation of ovarian tissue the exception.

RESULTS OF TREATMENT

Results of surgical treatment, including the patients who have had x-ray treatment, showed that in the solid group only 9.7 per cent of 72 patients survived for 5 years. In this study all patients living with disease at 5 years, or dying with disease after 5 years, have been considered as dead at 5 years. In the graphs this accounts for the sudden drop from 4½ to 5 years. Up to then it is interesting to note the very flat curve of the solid cancers of the ovary and the slowly dropping curve of the malignant papillary cysts. It is possible that the solid tumors are more surely cured if the tumor is removed than the papillary tumors which may more likely have small papillary areas of slowly growing tumor left behind after operation. End-results, according to histological classification, showed that the most favorable type in the solid group are the endometrial type while the pseudomucinous type was the worst. In the cystic group 21.9 per cent in 82 patients survived. Those classified as the pseudomucinous type did best in the cystic group, with 25.9 per cent surviving 5 years. The endometrial type did poorly. It is well to consider the endometrial type. This tumor, like cancer of the endometrium, does not become very malignant until it has grown outside the ovary or the uterus. Once free in the peritoneal cavity it is one of the most malignant of all pelvic tumors. In a series of cases of cancer of the endometrium reported from the Pondville Hospital (3) it was found that this tumor metastasized farther and more frequently than cancer of the cervix. Once it was outside the body of the uterus nothing could check its growth. It is understandable therefore why this tumor seems to be responsible for the most consistently bad end-results.

ROENTGEN-RAY TREATMENT

There can be no doubt that treatment by means of radiation following surgery is valuable, but it is the opinion of the author as a result of the study of these three reports that although roentgen treatment may slow or retard growth it does not cure. Perhaps after further experience with the million and the 500,000 volt machines a new type of treatment

will come about. At the present time life is prolonged but subsequent death is not prevented. X-ray treatment should be used in cases that have peritoneal extension, adhesions, whenever cyst fluid has been spilled, when a complete operation cannot be done, and in all cases in which there is any question as to the perfection of the surgery. If a clean and complete excision has been done radiation should not be used but should be withheld so that it can be used later if necessary. Roentgen treatment will slow up the growth of cancer deep in the pelvis. The present method of treating ovarian cancer can be improved upon. Although it is necessary to treat the entire abdomen the usual procedure is to treat only two or three fields. This cannot adequately cover the entire abdominal cavity, so that unless each field is marked off and treated certain areas are sure to be missed. It is very important to insist on accurate and thorough radiation if it is to be given. It is the surgeon's duty to make a note of the location of the metastatic areas, where the adhesions were, and where the tumor has extended. These areas should be marked on an abdominal chart and sent to the x-ray department when the patient is to be treated. The surgeon should discuss the lesion with the roentgenologist and decide where and how the tumor shall be treated. The roentgenologist should be called to the amphitheater at the time of operation. He cannot know the exact location of the tumor in the pelvis unless he sees it or is told. It is necessary that the surgeon himself show him where the tumor is or was. Although our group is not a large one it is well followed and studied and the treatment was the best that could be given at the Massachusetts General Hospital at that time. Most of the patients were treated with 200,000 volt machine, with the usual screening, amperage, and so on. The treatment has varied from time to time, as it has in other clinics. It is fair to assume that these patients were adequately treated so far as treatment was possible. Undoubtedly better results are being obtained but we have to report only a 0.7 per cent gain since the first paper was written. Eventually we will have better results but at the present time it is not the

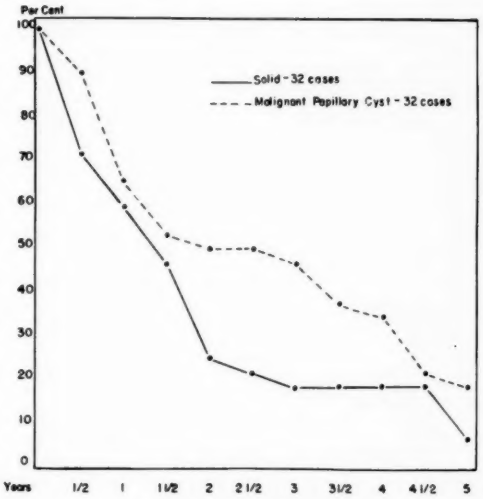

Chart 4. Radiated cases.

author's opinion that we are obtaining them. Fifty per cent of the radiation group had solid cancer with 6.2 per cent living 5 years without disease. This must be contrasted with 12.5 per cent living in a similar group not radiated. In the malignant papillary cystadenoma group also the patients not radiated did better than those who were radiated, 24 per cent as against 18.7 per cent. The groups were fairly comparable, there being inoperable cases in both groups and cases in which death from cancer occurred from 5 to 15 years later. It is apparent from this study as far as it goes that no more people were cured with radiation than without it. Up to the present time the greatest reliance must be placed upon surgery. It is more hopeful, however, to view the length of life in months of the patients having radiation, as compared to those not having it. Here it is clear that in the most malignant type, the solid tumors, radiation prolonged life, 20.9 months as compared to 7.5 months; but in the cystic group life was longer without it, 21.5 months compared with 22.9 months. Both series show that the treatment given was not of too great value. It is my belief, however, that much better results will be forthcoming and that further analysis of this peculiar group with due consideration given to the extent of disease and the amount

and type of radiation may show that radiation of ovarian cancer is of greater value than it now appears to be. Without choosing cases this type of therapy has not proved so valuable as we thought it would. When we learn what types of malignant disease of the ovary respond to radiation, that is the cell type, when we learn to confer and consult with our roentgenologists as to the proper places for treatment, and when the roentgenologist places the patient on the table himself and points the x-ray tube at the lesion, then I believe that our results will be better. Until full co-operation is obtained between the pathologist, who knows the histology of tumors; the surgeon, who knows the location of the lesion; and the roentgenologist, who knows how to get full value from his machine and how to place the patient and the tube, better results will not be obtained.

ANALYSIS OF STUDY

Cancer of the ovary is a very serious lesion and the solid type rates with the very worst of all malignant disease. The record at the Massachusetts General Hospital is not a brilliant one but it is likely that it represents at least the results of the community at large. The figures show, as the percentage of curability is only 15.5 per cent, that more propaganda for early treatment should be started. This tumor ranks with carcinoma of the stomach as one of the most serious of all cancers, for cancer of the breast, cervix, and rectum give better results. Ovarian cancer found early should be curable in many cases. It is our problem to try to find a way by which the diagnosis can be made early. Perhaps more careful histories, more heed to abnormal menstrual symptoms, hormone studies, and painstaking pelvic or rectal examinations of all women is a way to attack the problem. Exploration of the pelvis with the peritoneoscope is another method of attack. Our results will not be better until we are able to diagnose cases earlier. If these figures from the Massachusetts General Hospital are typical of those throughout the country then we must all change and insist upon radical surgery in every case. Having one ovary left in may cheer the patient, but it may be a very serious thing for her in the final analysis. Tapping of cysts first may make the incision smaller and the operation easier but it seems reasonable that the removal of a papillary or partially solid tumor *in toto* should prove more valuable in the end. Cancer of the ovary if found early is curable, for it is often encapsulated in the ovary and is not serious until the cyst is broken or perforated and the tumor has grown through the wall. It is far better to remove a simple cyst or a fibroid because of mistaken diagnosis than to wait to see whether a given lesion becomes malignant. The use of the peritoneoscope must be encouraged and a peritoneoscopist should be present in every hospital. X-ray should be reserved for those patients in whom it has been impossible to do perfect work. To feel any reliance upon it as a method of clearing up a poorly done operation is very undesirable. I believe that the co-operation of the surgeon, the pathologist, and the radiologist in outlining the treatment for a patient with cancer of the ovary will probably prove to be the most valuable part of any advance in roentgen treatment.

SUMMARY AND CONCLUSIONS

Cancer of the ovary of the solid type is a very serious neoplasm.

Cancer of the ovary of the malignant papillary cystadenoma type is about as malignant as any other epithelial growth.

Early diagnosis and methods for early diagnosis are necessary to improve the end-results.

The use of the peritoneoscope should prove of extreme value.

Bilateral oophorectomy with total hysterectomy is the proper treatment.

Involvement of the uterus, adhesions, and growth through the wall of a tumor are extremely dangerous.

The rupture of cysts before and during operation is condemned, but the results of this series cannot support the condemnation. It is the author's belief that spilling of cyst contents should be avoided.

X-ray treatment to date has not proved of much curative value but more modern methods may.

It is obvious from our study that it is necessary to have the co-operation of the surgeon, the pathologist, and the roentgenologist in the treatment of tumors of the ovary before more favorable results can be obtained.

Every cystic or solid tumor of the ovary that is removed singly should be opened by the surgeon before the wound in the abdomen is closed.

If cancer is found in a single ovary by the pathological department resort should not be made to radiation but the patient should be re-operated upon and radical surgery carried out.

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APPENDICITIS AMONG INDIVIDUALS MORE THAN SIXTY YEARS OF AGE

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THE greatest mortality for acute appendicitis occurs in patients more than 60 years of age. This can be attributed to the fact that the diagnosis is frequently overlooked or delayed because of the patient's age and because of the mildness and variability of the symptoms. For this reason it seemed advisable to us to review our cases of acute appendicitis which had occurred in individuals who were more than 60 years of age.

Approximately 1 to 2 per cent of all patients with acute appendicitis are more than 60 years of age. Taylor stated that, of 1000 patients with acute appendicitis admitted each year to the London Hospital, 1.5 per cent were more than 60 years of age. Maylard found that 1.5 per cent of 1000 consecutive cases at Victoria Infirmary occurred in patients between 60 and 70 years of age and only 0.3 per cent in those more than 70 years of age.

The mortality of acute appendicitis in this group is variously reported at about 25 per cent. Taylor, in a series of 110 cases, reported a mortality of 20 per cent. Wood, in a series of 43 cases at the Peter Bent Brigham Hospital, had a 28 per cent mortality. Fitch, in a series of patients between 60 and 70 years of age, had a 54 per cent mortality. The most common cause of death in these various series has been general peritonitis. Pneumonia has been next most frequent, whereas pulmonary embolism, cerebrovascular accidents, cardiac failure, septicemia, intestinal obstruction, and others have each accounted for a small percentage.

The pathological picture has been described by Taylor. He has stated that "the almost constant course of acute appendicitis in old people is therefore—the first day, engorgement; second day, gangrene and local peritonitis; third day, perforation with general peritonitis or abscess formation; fourth day and after, abscess." This is the pathological picture as described by others and as seen at the Mayo Clinic. Most authors have pointed out the atypical picture and mildness of symptoms which are presented by the majority of these patients.

In the majority of the 110 patients seen by Taylor in whom appendectomy was performed, the appendix was gangrenous and peritonitis was frequently present. Abscess formation had taken place in a large group and only drainage was instituted. Wood's series showed 55 per cent of the cases with appendiceal abscesses, 9 per cent with general peritonitis, and 16 per cent with a gangrenous appendix at operation.

In the present paper a series of 82 cases of acute appendicitis which were seen from 1924 through 1938 at the Mayo Clinic is reviewed. A few cases in which operation was performed during the early part of the year 1939 are included to illustrate better the diagnostic problems which are presented.

There were 33 women and 49 men. Seventy patients were between 60 and 70 years of age and 12 were between 70 and 80 years of age. The youngest patient was 60 and the oldest 78 years, with an average of 65.1 years. I have operated upon a number of these patients and my observations, together with the results of treatment in these cases collected from the records, are briefly summarized.

The appendix was ruptured in 51 of the 82 cases, whereas in 31 it was unruptured. Appendectomy was performed in each of the 31 cases without rupture. In the 51 cases with a ruptured appendix, appendectomy was performed in 26 and simple drainage in 20 with a subsequent appendectomy in 8 of these 20 cases. Conservative, non-operative treatment was instituted in 5 of the 51 cases with a ruptured appendix.

There were 13, 15.9 per cent, deaths in the entire series. Nine deaths occurred in the se-

From the Division of Surgery, the Mayo Clinic.

ries in which the appendix was ruptured, 8 being due to general peritonitis and 1 to pneumonia. Five of the 9 deaths occurred in that group in which appendectomy had been performed whereas 2 occurred in each of the 2 other groups, namely those having simple drainage and those receiving conservative non-operative treatment. In the series of 31 cases without rupture there were 4 deaths of which 2 were due to pneumonia, 1 to cardiac failure, and 1 to pulmonary embolism.

The type of anesthesia employed for the operation seemed to have no apparent influence on the mortality rate, as approximately the same number of patients received spinal anesthesia as received general gas-ether anesthesia and approximately the same number of deaths occurred in each group.

The pathological picture in relation to the time element is interesting in these two groups. In the 31 cases in which the appendix was unruptured there were 17 cases with gangrenous appendix while the 14 remaining showed varying degrees of acute purulent appendicitis. Of this entire group there were 20 cases in which the disease was of less than 24 hours' duration, 8 cases of less than 48 hours', and only 3 of more than 48 hours' duration. The history was considered atypical in 20 of the 31 cases of this group.

In the series of 51 cases in which the appendix was ruptured there were only 17 cases in which the disease was of 48 hours' duration or less. In several instances it had been present several days to even a few weeks before the first examination at the clinic. There were 29 patients with general peritonitis, 11 with abscess formation, 7 with gangrenous appendix and some degree of localizing peritonitis, and 4 in whose cases the pathological condition was not described. The history in at least 30 of these 51 cases in this group can be considered as atypical.

SYMPTOMS AND DIAGNOSIS

One is impressed by the fact that the clinical syndrome of acute appendicitis in this older age group differs somewhat from that manifested in youth. Any categoric statements concerning the symptoms of appendicitis in the aged, and their sequence of occurrence, become more obviously unreliable as these cases are studied in detail. When at least 50 of the histories in these cases were considered as atypical, the standard of reference was the usual textbook story of appendicitis with epigastric distress, then pain in the lower right quadrant, nausea, vomiting, and so forth. This textbook picture of appendicitis may and does occur in people of the older age group, but it occurs sufficiently infrequently that it might be called the atypical picture of acute appendicitis in patients more than 60 years of age.

In these patients, as has been mentioned, a characteristic attack of appendicitis may develop, but there seems more likely to be lower abdominal pain with localization over McBurney's point, leucocytosis, but frequently no fever, nausea, or vomiting. These findings may be all that is present for 2 or 3 days, or even a week, before more toxic symptoms develop. The more severe symptoms which then appear are usually those of either localized or diffuse peritonitis.

In the majority of instances the patient has a rather mild cramp-like, intermittent type of general lower abdominal pain. This is associated with a mild indescribable dyspepsia and constipation. The pain is usually considered as being due to constipation and a cathartic or an enema is taken. This pain tends to localize in the right lower quadrant of the abdomen and tenderness develops over McBurney's point. If a leucocyte count is taken it is found to be elevated to between 9,000 and 15,000 in each cubic millimeter of blood. Occasionally the pain begins as a dull ache at McBurney's point and remains localized. Anorexia and, in a few instances, some degree of nausea are present. There is usually no vomiting, but occasionally the patient vomits once or twice in the early phases. However, this has subsided completely by the time the patient is seen. There is very little if any constitutional disturbance and the amount of pyrexia, if any is present, is small. Ordinarily the temperature is normal to slightly more than 99 degrees F. The pulse rate may be slightly elevated, but not significantly so. Frequently, as the symptoms progress, the cramp-like pains become more severe and abdominal distention

becomes apparent. This distention, together with the pain, and the patient's age, is often interpreted as intestinal obstruction due to a malignant condition of the colon.

Thus, early in appendicitis in this age group there develops a lower abdominal cramp-like pain with localization at McBurney's point, tenderness in this region, and leucocytosis. In spite of the fact that within the next 48 hours the appendix usually becomes gangrenous and subsequently ruptures, the symptoms are still not acute enough for the patients to seek medical aid. Thus the majority of our patients had peritonitis and it was because of the symptoms of this peritonitis that they sought aid. As the appendix becomes gangrenous and peritonitis develops the picture resembling intestinal obstruction becomes even more apparent and frequently when patients are admitted at this phase, much valuable time has been lost in an attempt to locate a suspected neoplasm. As peritonitis develops, more symptoms of toxicity manifest themselves and the patient may have considerable vomiting and fever. However, other patients remain ambulatory throughout the entire course of their illness and come because a mass has developed in the right lower quadrant of the abdomen. This mass is usually proved to be an abscess.

REPORT OF CASES

Brief reports of a few illustrative cases are of interest.

CASE 1. A man, aged 60 years, came to the clinic complaining of a para-umbilical cramp-like pain of 16 hours' duration which localized in the lower right quadrant of the abdomen. He had not had nausea, vomiting, or other symptoms. There was tenderness of grade 3 on the basis of 1 to 4 over McBurney's point. The temperature was 99.2 degrees F. and the pulse 80. The leucocytes numbered 14,000. An acutely inflamed appendix, with abscess formation in its tip and with marked peri-appendicitis, was removed.

CASE 2. A woman, aged 62 years, was being examined in the clinic when a steady aching pain developed in the lower right quadrant. This was associated with tenderness over McBurney's point and a leucocyte count of 11,700. There was no fever. The pain was of 12 hours' duration when the appendix was removed and acute purulent appendicitis with marked peri-appendicitis was found.

CASE 3. A rather marked constipation developed in a man, 68 years of age, while he was recovering from amputation of a leg. A dull aching pain subsequently developed in his lower right quadrant with tenderness over McBurney's point. There was no nausea and no vomiting. The temperature was 99 degrees F. and the pulse rate 80 beats per minute. Leucocytes numbered 19,000. A gangrenous necrotic appendix with localizing peritonitis was found at operation.

CASE 4. A man, aged 72 years, was seen at the clinic, with a cramp-like lower abdominal pain of 24 hours' duration. He had had two cerebrovascular accidents and had Parkinson's disease and bilateral scrotal hernias. This pain localized at McBurney's point and was associated with tenderness. The patient vomited once at the onset but this had subsided. His abdomen was distended and visceral activity was slowed up. The temperature was 101 degrees F. with a pulse rate of 100. The leucocytes numbered 11,600 with 92 per cent neutrophils. At operation a ruptured gangrenous appendix with localized peritonitis was found.

CASE 5. A man, aged 66 years, was referred here with the diagnosis of intestinal obstruction. Forty-eight hours before admission a rather sharp cramp-like umbilical pain which was referred to his lower right quadrant had developed. This was associated with vomiting and marked abdominal distention. On admission there was much tenderness over McBurney's point. The abdomen was distended grade 3 on the basis of 1 to 4, but was rather soft and doughy to the touch. A roentgenogram showed gas in the small intestine and colon, and while not diagnostic, was, however, suggestive of intestinal obstruction. The temperature was normal, but the pulse rate was 110 beats per minute. The leucocytes numbered 13,400 and the blood urea was 50 milligrams. At operation a general peritonitis was present and an acutely gangrenous appendix with rupture easily presented itself; it was removed. The patient recovered.

CASE 6. A woman, aged 68 years, came to the clinic 1 month after the onset of symptoms. She had had a steady aching pain in the lower right quadrant of the abdomen. A few days after its onset there was a slight fever which gradually increased to 101 to 103 degrees F. and at the end of 2 weeks a mass in the lower right quadrant of the abdomen was apparent. On admission here this mass was present. The temperature was 101 degrees F. Leucocytes numbered 10,800 with 75 per cent neutrophils. At no time had there been nausea or vomiting and the patient had never felt very ill. She was suspected at first of having carcinoma of the cecum, but exploration revealed an old appendiceal abscess with a ruptured purulent appendix.

CASE 7. A man, aged 69 years, was being examined in the clinic because of diabetes and prostatic hypertrophy. Following massage of the prostate, lower abdominal cramp-like pain developed which localized in the lower right quadrant of the abdomen. There was an associated tenderness over McBurney's point and a leucocyte count of 11,000. There was no

fever, nausea, or vomiting. The patient took salts and did not report to the clinic for 48 hours at which time the aforementioned findings were present. Drainage was instituted for acute appendicitis with rupture and general peritonitis.

CASE 8. A man, aged 73 years, went to his physician elsewhere because of epigastric distress with nausea. He was given alkalis with no benefit. The following day the pain localized in the lower right quadrant and he vomited, but because of his age he was still treated conservatively. On the third day the patient was referred here. There was much tenderness over McBurney's point and considerable gaseous distention of the abdomen. The temperature was 101 degrees F. and the pulse 100. The leucocytes numbered 16,200 with 90 per cent neutrophils. An appendectomy was performed for acute gangrenous appendicitis with perforation and localizing peritonitis.

CASE 9. A man, aged 70 years, came to the clinic because of a generalized lower abdominal soreness which was most severe over McBurney's point. This had been present for 3 days. He had vomited once at the onset, but had been up and around and had taken cathartics. There was no fever. On admission he had a tender mass in the lower right quadrant of the abdomen. The pulse was 100. The leucocytes numbered 17,800. He had an acute ruptured appendix with an appendiceal abscess which was drained.

TREATMENT

The diagnostic problem of the elderly patient with acute appendicitis as illustrated by these case reports is very different from that of the young one, but on the other hand it is felt that the surgical treatment should not be considered significantly different. In the uncomplicated cases the mortality is low and the patient more than 60 years of age stands the operation well. However, in the complicated cases, that is, in those cases in which there is a ruptured appendix with peritonitis, the mortality can be reduced by conservatism in the surgical procedure. In the main it is felt that there is no doubt that appendectomy should be the treatment of early acute appendicitis prior to perforation. In the face of a recently perforated appendix without definite localization of the peritonitis, immediate operation with drainage of the peritoneal cavity should be done.

If the patient's condition warrants it and if it can be done without greatly prolonging the operation, spreading the infection, traumatizing the infected tissues, and without undue breaking down of protective adhesions, appendectomy should be performed. It must be said in this regard that elderly people seem to be able to make one effort to limit the peritonitis by adhesions, but if these are broken down the pus will spread, even though the source of infection is removed. For this reason, one must be more conservative in this group than in patients of a younger age group, in regard to the removal of the appendix when perforation and peritonitis are present. The greatest mortality of the entire series occurred in that group in which appendectomy was done in the presence of peritonitis.

Occasionally when definite perforation and peritonitis have been present for several hours to days and the patient's condition is poor, the conservative Ochsner type of treatment should be instituted. If peritonitis appears to be localizing, conservative treatment should be carried out for a few days until the abscess can be drained. Occasionally this type of abscess absorbs itself so that no immediate surgical treatment is needed. When an abscess is drained, no attempt should be made to remove the appendix unless it is free in the cavity of the abscess.

The question of subsequent appendectomy in these cases in which drainage alone has been done presents more of a problem than in the younger patient. However, it is felt that if the patient's condition warrants it he should be advised to return in 6 to 12 weeks for subsequent appendectomy. Owing to the fact that the appendix in these patients is prone to become gangrenous, one will occasionally find at this subsequent operation that the entire appendix has sloughed away.

With regard to the anesthetic in this series of cases, it has been almost exclusively either a gas-ether mixture or a spinal procaine preparation. The incidence of pulmonary complications and the incidence of death from any cause were about the same for each method. However, in these cases, appendectomy, if possible, was the object of the operation and complete relaxation of the abdominal wall was demanded of the anesthetist. But if operation is undertaken with specific purpose of drainage only and even if appendectomy is to be performed through a McBurney type of incision and the patient is slender, a combination

of regional anesthesia with procaine solution and intravenous pentothal sodium is often satisfactory. In addition to a careful individual selection of the anesthetic agent for each case, an active postoperative regimen which is directed toward the prevention of pulmonary complications is instituted.

ANALYSIS OF STUDY

The diagnosis of acute appendicitis in individuals more than 60 years of age, even when a characteristic history is obtainable, is frequently overlooked because of the rarity of the disease. One should become increasingly on the alert for the possibility of acute appendicitis in the diagnosis of any intra-abdominal symptoms in these patients. The symptoms of this entity may follow the established clinical, clear-cut sequence, but again the symptoms may be entirely atypical, and so closely simulate the picture of intestinal obstruction and carcinoma that operative interference may be delayed. Any patient in this age group in whom lower abdominal cramp-like pains develop with localization and tenderness over McBurney's point and with a leucocytosis must be suspected of having acute appendicitis.

Several hypotheses have been proposed as to why this group should present such modified symptoms of their disease. There is every reason to suppose that the peritoneum and the appendix of a patient in the late decades should react differently to inflammation than they would have reacted in youth, for it has been demonstrated that the appendix shows an increasing amount of lymphoid tissue up to the age of 20, but that from this period on there occur atrophic and fibrous changes. Then too, the sensitivity of these people to pain is less than in youth and psychologically there is an inclination of age to conceal illness. The presence of constipation in a large percentage of these patients seems significant. One cannot overlook the importance of vascular changes with certain degrees of impairment and slowing of the circulation. In many of these cases the causation of the appendicitis could be satisfactorily explained on the basis of a combination of these factors with a certain degree of appendiceal obstruction. The obstruction is usually caused by the presence of an impacted fecalith, but occasionally it is caused by some anatomical deformity of the appendix as a result of its position, by adhesive bands, by contraction of the mesentery, and the like. Any one of these factors together with the presence of the aforementioned factors could easily predispose to the type of appendicitis under discussion.

Though fecaliths were found obstructing the lumen in several of these cases, it is likely that the other causative factors of obstruction are of more significance in this older group than in younger patients. This can be explained by the pathological changes as mentioned which are taking place as a result of age and of the repeated attacks of appendicitis which many of these patients have had with resulting shortening of the mesentery, the formation of intraluminal septums and the like. When one or more of these factors which might cause obstruction are present and there is an already retarded circulation, with a decreased tissue resistance due to the disappearance of the lymphoid elements, it seems reasonable that when appendiceal obstruction occurs the course of the disease should be rapid with early gangrene, perforation, and peritonitis. Inasmuch as appendiceal obstruction early produces only localizing symptoms, one would not expect more symptoms in this group. This phenomenon, however, does not occur in every case, but it occurs in some cases and probably occurs in many more than have heretofore been recognized. A pathological study of a large series of appendixes has been made recently and the high incidence of obstruction was noticeable.

In performing operation in this group one must modify, to a certain extent, the treatment applied to the younger patient. Both the patient and the course of the disease are different. Not only is the patient a poor operative risk, demanding the minimum of manipulation and anesthesia, but the appendix is almost always gangrenous or about to become so. Peritonitis is usually present to some degree. These patients do not tolerate peritonitis well and every effort should be made to avoid further dissemination of infection. This can be done by conservatism in the surgical

treatment. Often simple drainage without further exploratory measures will bring about the best results.

SUMMARY

A series of 82 cases of acute appendicitis occurring in individuals more than 60 years of age is reviewed. The clinical manifestations of the disease were atypical in more than one-half of the cases. Perforation of the appendix had occurred in 51 cases prior to treatment. The clinical and pathological picture presented and the surgical treatment found most satisfactory in these cases are discussed.

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THE EFFECT OF PREGNANCY ON THE EXCRETION OF INTRAVENOUS DIODRAST IN RABBITS

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ANIMAL experimentation has led to diametrically opposed conclusions regarding the effect of pregnancy on the urinary tract. Mengert, in an extensive study of pregnancy in the cow, dog, cat, rabbit, guinea pig, rat, hog, and monkey, concluded that the ureters of those animals did not dilate during pregnancy; that there was significant increase in the proportionate area of the ureteral sheath in the monkey and cow; and that pregnancy showed no effect upon the ureters of common animals. He found that the average diameter of the ureter in the rabbit was slightly larger in the pregnant than in the non-pregnant, but considered the difference too slight to be of significance. Payne and Hodes, in a much less extensive study after injection of prolan, estrin, progestin, and in the normally pregnant rabbit, concluded that there is no ureteral dilatation in rabbits. Hundley, Siegel, Hachtel, and Dumler found no significant changes in the ureters after estrogenic injections in castrated dogs, as compared to castrated controls.

On the other hand, Bollinger found that in dogs the excretion of sodium thiosulfate is depressed in from 1 to 3 weeks after conception, until delivery. Rossi found in intravenous urography in desiccated rabbits that there is definite evidence of delay in the production of the best concentration of the dye (best plate in the series) and that there is filling farther down the ureters in the pregnant than in the non-pregnant rabbits. He attributes this to atonicity of the ureteral musculature, which delays the progression of the ureteral contents. His figures are as follows. The best plate in the non-pregnant rabbit is obtained within 3 to 5 minutes after injection of the media. In the same rabbit when 21 to 25 days pregnant, the best plate is at 18 to 25 minutes after the injection of the media. He notes that these changes are manifest a few days after conception, reach a maximum by the twenty-first to twenty-fifth days of pregnancy, and then decrease in the last few days before delivery. Pregnancy in the rabbit is 30 days.

Of necessity, in animal experimentation there are certain factors which are capable of vitiating results to some degree. Two undoubted factors here, as in human pregnancy, are marked variation of individual animals in response to pregnancy and, as indicated by Hortolomei, the ureters have a tendency to fill more completely when the bladder is full. In rabbits, urination is not controllable by the investigator and catheterization of the rabbit introduces an undesirable factor into the experiment. Finally, Van Wagenen and Jenkins have demonstrated in monkeys that ureteral dilatation occurs in the very latter part of pregnancy. They have further shown that if the fetus be removed but the placenta allowed to remain to term, ureteral dilatation not only persists but is apt to increase in degree.

There have been investigations on the effect of the urine of pregnant women and of extracts of the glands of internal secretion, particularly folliculin, corpus luteum, and the gonadotropic hormones, in isolated ureters from animals. Villaret and his coworkers found that the urine of women near term inhibited the motility of the dog ureter *in vitro* in 12 of 13 ureters studied. Bompiani showed that there were substances in the urine of pregnant women capable of modifying the activity of the animal ureter kept alive *in vitro*. He considers pregnancy to be a physiological condition accompanied by a hormonal crisis. This crisis, which reaches an equilibrium, is probably responsible for pyelo-ureteral hypokinesis. This state affects energy, rhythm, tone, and, consequently, peristalsis of the efferent channels of the kidney. Contiades reported changes in the cow and the dog which are similar to those

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of man. He found, through tests of motility at the various months in pregnant women, that the urine of human pregnancy at the eighth and ninth month showed its major effect upon the isolated dog ureter. Burrows, after long administration of estrogenic substances in mice, found that there was a dilatation of the bladder and ureters, with hydronephrosis occurring with some frequency. In some of his mice, a purulent pyelitis and cystitis occurred. Grossu-Streja and Georgesco studied pig ureters. They conclude that folliculin, corpus luteum extract, and the gonadotropic hormone inhibit ureteral peristalsis to some extent. Schmitz finds the influence of hormones on isolated pig ureter not constant.

Pyelonephritis and ureteral dilatation have been recognized in veterinary medicine. Mirabeau mentions bilateral pyelonephritis in cattle. Jones and Little described 13 autopsy protocols which showed the renal lesion to be very like pyelonephritis in the human being. He believes that pregnancy plays an important part in increasing the severity of the disease. The untoward effects of these infections are most apt to appear in the latter part of pregnancy and in the puerperium. The pyelonephritis of pregnancy is almost universally fatal. Fraser, Godden, and Thomson described a calcium deficiency in sheep which they compared symptomatically with "pregnancy disease" which seems to be a toxic condition, but which sometimes shows renal and fever manifestations. Loebl described pyelonephritis in a sow with autopsy findings. Vontobel, McIntosh, and Hall-Masheter have contributed further in these reports of urinary disease in animals. Boyd and Bishop note that the condition has long been recognized in Europe but was not reported in the United States until 1918. The infection is now known to exist in most parts of this country. He finds it seldom recognizable until just before delivery, or in the puerperium. By means of rectal examinations, thickened ureters and bladder wall can be palpated. Ureters have been shown at autopsy which were filled with pus and débris and measured from 2 to 6 centimeters in diameter. Baker, in discussion of Boyd and Bishop, mentioned that a similar condition existed in ewes. The condition was universally fatal. He had produced abortion by the use of pituitrin and saved some of the sheep. Hadleigh Marsh, veterinary pathologist of the research laboratories of Bozeman, Montana, states in a personal communication that he has not noted or heard of pyelonephritis in range cattle, but it might exist unrecognized. He has seen it in beef cows twice and once in the college herd. Schoening, head of the pathological division of the Bureau of Animal Industry, Washington, D.C., refers those interested to the text, *The Practice of Veterinary Medicine*, by D. H. Udall, 1936.

One source of confusion, which has led to opposite points of view on the influence of pregnancy on the urinary tract in animals, is the attempt which some observers have made to make animal pyelography approximate human pyelography. This has led to denial that pregnancy influences the ureters of animals, because pelvic and ureteral dilatations which are comparable to those commonly seen in human beings are not produced in quadrupeds.

Of some interest are the observations by qualified physicians who have worked among the aborigines, who state that they have not seen urinary infection in pregnancy in practice among these people.

Analysis of the present point of view among investigators of the urinary changes in pregnancy in man indicates almost complete agreement among them that there is a double etiology for these changes. The primary factor is atony of the musculature, which leads to the slowing of the conveyance of the urine from the secreting unit, the cortex; weakening of the ureteral jet; and, in pyelography, delay in filling, which seems to be due chiefly to failure of the dye to be distributed. The second factor is pressure of the pregnant uterus against the exposed portion of the ureter, where it crosses the brim of the bony pelvis. In quadrupeds, this pressure factor is for the most part, if not completely, absent. It is not to be expected that the pregnant animal will demonstrate large pelvo-ureteral dilatations except in the presence of complications or when there is plugging of the channels with pus, blood, and débris. Therefore, the significant test of the influence of pregnancy on the urinary channels

Fig. 1. Compression band.

in animals will be whether or not the musculature of the urinary tract evidences pregnancy atony.

It has seemed to us that Rossi's observations were of such significance that they were worthy of repetition. In addition, we have attempted to add a mechanical appliance which would supply the pressure factor. The latter venture was not wholly successful. It was not possible to apply the apparatus satisfactorily in all cases. The rabbit's bladder was sometimes full of urine, sometimes nearly empty, and the period of application was necessarily short as compared with the probable duration in animals which are more nearly erect, and in man in whom the pressure factor is the result of natural processes.

Method of study employed. In this study, we have followed as nearly as possible the methods which had been used by Rossi. In addition, an attempt was made to apply pressure at the pelvic brim, both in the pregnant and non-pregnant rabbits, that there might be a comparison between the effects of pressures in the two states. (The same rabbits were used throughout the experiments.)

A virgin rabbit was filmed for record. Ten cubic centimeters of diodrast was injected into the ear vein. The injection time was recorded. A film was exposed during the injection and at 1 minute intervals after the injection, until the concentration of the dye in the urinary tract began to diminish. After the lapse of sufficient time for the elimination of the dye from the circulation, usually 2 hours or more, a film was taken to indicate that point. After a pressure apparatus (Fig. 1) had been applied for 5 minutes, the rabbit was reinjected with 10 cubic centimeters of diodrast. The pressure apparatus consisted of an elastic webbing with a buckle and two fitted blocks of wood, which were of suitable size and shape to fit over the pelvic bones and compress the abdominal contents and the ureters against the iliopsoas muscles. The injection time was recorded and the time at which the filling of the kidney was determined as before, to produce the best concentration of the dye. Films were taken at 1 minute intervals, as they were in the experiment without pressure. The rabbit was then exposed to a male, under supervision of a caretaker. When served, the date was recorded. Between the twentieth and twenty-fifth day of pregnancy, the rabbit was reinjected with 10 cubic centimeters of diodrast and a plate was taken immediately and then at 5 minute intervals until the density of the dye began to fade. After the lapse of 2 hours, the rabbit was given pressure for 5 minutes and again injected with 10 cubic centimeters of diodrast. Films were taken immediately and at 5 minute intervals until the dye began to fade.

Eight rabbits were used in the experiments. Two rabbits died after the preliminary radiations. Two rabbits failed to become pregnant. The x-ray exposure was 400 milliamperes at 1/40th of a second, with the tube at a distance of 42 inches. The films obtained in these experiments were examined under proper lighting and the width of the ureter determined in millimeters, by caliper measurement, and the length of the filling toward the bladder recorded. A source of error in the latter measurement was the frequency with which a clearly visible ureter passed over onto the vertebræ and became lost to view. If error exists due to this cause, it is in the nature of incomplete record of the actual length of ureter which appeared and would probably indicate an even more pronounced effect of pregnancy since, with one exception, this difficulty was encountered in the pregnancy cases. In the non-pregnant cases, especially without pressure, ureteral filling which extended much below the renal pelvis was seldom seen.

In stating the results of this study, the right kidney is referred to as the high kidney and the left as the low kidney. This terminology is employed for ready reference to the pyelography.

Following is a summation of the time at which the best plate in each series was ob-

tained: for non-pregnant without pressure, 2.6 minutes; for non-pregnant with pressure, 3.4 minutes; for pregnant without pressure, 16.0 minutes; for pregnant with pressure, 11.0 minutes.

It is to be noted that there was little difference shown in filling time in normal rabbits, whether pressure was applied to the ureter or not. There was an appreciable increase in filling time in pregnancy without pressure on the ureters. Even with pressure applied, the filling time in pregnancy was much longer than in the non-pregnant. In the non-pregnant, it was noted that the ureter frequently filled down to the obstructing clamp, but it remained a thin line in most instances. In one or two ureters in the non-pregnant, there seemed to be some widening of the lumen from pressure.

Since 4 of the rabbits were not available for test in pregnancy, either because of death in the intervals between tests or because of failure to become pregnant, a different number of ureters were examined in the non-pregnant than in the pregnant. Two tests are recorded for each non-pregnant animal; i.e., non-pregnant without pressure and non-pregnant with pressure. The same applies to the ureters in pregnancy. Of the non-pregnant animals 11 of possible 32 ureters filled, or 34.4 per cent; of the pregnant, 11 of possible 16 ureters filled, or 68.7 per cent. These figures indicate that there is a definite trend toward filling more of the ureter in pregnant than in non-pregnant states, whether or not the filling is favored by the addition of pressure obstruction to the lower ureter.

Rabbit 1. Brown and white. Tag No. 87. *Non-pregnant, without pressure.* A plain plate was taken previous to injection. Seven cubic centimeters of diodrast was injected into ear vein with some difficulty; injection time, 2¾ minutes. The first film was taken at 1 minute after injection was begun and 5 cubic centimeters of diodrast had been injected. A second plate was made at 1 minute, 25 seconds; a third plate at 2 minutes; a fourth plate at 3 minutes; a fifth plate at 4 minutes; a sixth plate at 5 minutes. The best plate was taken at 3 minutes.

Non-pregnant, with pressure. Reinjected after 2 hours, 59 minutes with 10 cubic centimeters of diodrast into ear vein. Injection time was 38 seconds. Pressure appliance was left in place for 5 minutes previous to injection. The best plate was obtained immediately at the close of the injection. Other plates were made at 1, 2, 3, 4, and 5 minutes.

Pregnant, without pressure. 21 days pregnant. Three fetal bodies were palpable. Ten cubic centimeters of diodrast was injected into the ear vein. The injection time was not recorded. Plates were made at 5, 10, 15, and 20 minutes after injection. The best plate was made at 20 minutes.

Pregnant, with pressure. Pressure was applied for 5 minutes before each plate was taken. Plates were made at 5, 10, 15, and 20 minutes. The best plate was made at 5 minutes (Fig. 2).

SUMMARY OF EXPERIMENT, RABBIT 1

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	3	1	29	Pelvis well filled but ureter faint	1	21	
Non-pregnant pressure	Immediately	1	26		1	Filled	Tiny fine line but distinct
Pregnant*	20	1	Well filled throughout		1.5	Well filled	
Pregnant pressure	5	3	42.5	Passes onto spine	2.5	Well filled	Faint after 3d lumbar vertebra

*Bladder abnormally shaped. Impression on upper border due to pregnant uterus.

This rabbit's films have been used to illustrate the type of changes which are characteristic of these experiments. Figure 2, a, shows the non-pregnant without pressure film; b, the non-pregnant with pressure film; c, the pregnancy without pressure film; and d, the pregnancy with pressure film. In c, note the abnormally shaped bladder with impression from uterus. In Figure 3 are shown halftones of the filling of the pelvis and ureters. These halftones are made from caliper measurements from the photographs. They are not intended to replace the x-ray films, but to indicate the course of the ureters in the photograph.

Rabbit 2. All brown. Tag No. 88. *Non-pregnant.* Ten cubic centimeters of diodrast was injected in 40 seconds. Two plates were taken during injection, at 15 seconds and 40 seconds. Plates were made at 1, 2, 3, 4, and 5 minutes. The best plate was made at 3 minutes.

Non-pregnant, with pressure. Animal was reinjected after 2 hours, 50 minutes. Ten cubic centimeters of diodrast was injected into the ear vein. Injection time was 34 seconds. Plates were made at 34 seconds, 1, 2, 3, 4, and 5 minutes. The best

plate was taken at 3 minutes. Rabbit failed to become pregnant.

SUMMARY OF EXPERIMENT, RABBIT 2

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling	Comment
Non-pregnant	3	1	25	Passed over vertebra	.5	Filled	Very faint
Non-pregnant pressure	3	1.5	38	Passed over vertebra	1.5	Filled	

Rabbit 3. Black and grey, white face and neck. Tag No. 89. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters diodrast was injected into the ear vein; injection time, 40 seconds. Plates were taken at 20 seconds (5 cubic centimeters) and at end of injection, 1, 2, 3, 4, and 5 minutes. The best plate was made at 1 minute after completion of the injection.

Non-pregnant, with pressure. Rabbit was reinjected after 2 hours, 47 minutes. Ten cubic centimeters diodrast was used. Injection time was 20 seconds. Plates were made at 20 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was made at 4 minutes. Rabbit failed to become pregnant.

SUMMARY OF RESULTS IN RABBIT 3

	Low kidney			High kidney	
	Best plate min.	Diameter	Filling	Diameter mm.	Filling mm.
Non-pregnant	1	Gas in abdomen, not measurable		2	20
Non-pregnant pressure	4	2 mm.	Filled	2.5	64

Rabbit 4. Large rabbit. No tag. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected; injection time, 50 seconds. Plates were made at end of injection, and at 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 3 minutes.

Non-pregnant, with pressure. Injection was made after 2 hours, 2 minutes. Injection time was 26 seconds. Plates were taken at 26 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was made at 4 minutes. Rabbit died on fourth day after experiment.

Rabbit 4a. Replacement for Rabbit 4. Plain plate before injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected into the ear vein. Injection time was 30 seconds. Plates were made at 30 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was made at 4 minutes.

Non-pregnant, with pressure. Injected 2 hours plus after the first studies, with 10 cubic centimeters of diodrast; injection time, 13 seconds. Plates were

SUMMARY OF RESULTS IN RABBIT 4

	Low kidney				High kidney		
	Best plate min.	Diameter ureter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	3	?	22	Very faint	1.5	30.5	Faint
Non-pregnant pressure	4	1.5	Filled		1.5	55	Passes onto vertebra

taken at 13 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 3 minutes.

21 days pregnant. Ten cubic centimeters of diodrast was injected in 53 seconds. Plates were made at 5, 10, 15, and 20 minutes. The best plate was obtained at 10 minutes.

21 days pregnant, with pressure. Six cubic centimeters of diodrast was injected into the ear vein. Injection time was 1 minute, 54 seconds. Plates were made at 5, 10, 15, and 20 minutes. The best plate was made at 10 minutes.

SUMMARY OF EXPERIMENT, RABBIT 4A

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	4	1	32	Excellent pelvis	1.5	5	Onto vertebra
Non-pregnant pressure	3	2	Filled		1.5	Filled	
21 days pregnant	10	1	Filled		1.0	Filled clearly	
21 days pregnant pressure	10	1	15	Much more densely than without pressure	2	38	More densely than without pressure

Rabbit 5. White shoulders and front legs. Plain plate previous to injection. *Non-pregnant.* Ten cubic centimeters of diodrast was injected into the ear vein in 43 seconds. Plates were made at 43 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was made at 1 minute.

Non-pregnant, with pressure. Injection of 10 cubic centimeters of diodrast into ear vein was made 1 hour, 55 minutes after first experiment. Injection time was 6 minutes. Pressure was applied for 16 minutes previous to taking of the plates. Plates were made at 1, 2, 3, 4, 5, and 6 minutes. The best plate was made at 5 minutes. Actually, the best plate was obtained 11 minutes after the beginning of the injection. Most of the injection was given nearer to the end of the 6 minutes than to the beginning.

Rabbit died 22 days after the completion of the first experiment without becoming pregnant.

a b c d

Fig. 2. Rabbit 1. a, Non-pregnant, without pressure—best plate, 3 minutes after injection. b, Non-pregnant, with pressure. c, Pregnant, without pressure. d, Pregnant, with pressure.

a b c d

Fig. 3. Rabbit 1. This drawing was made by means of caliper measurements from photographs, and shows the filling of the pelvis and of the ureters. a, Non-pregnant, without pressure. b, Non-pregnant, with pressure. c, Pregnant, without pressure. d, Pregnant, with pressure.

SUMMARY OF EXPERIMENT, RABBIT 5

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	1	1	Filled		1.5	43	Passes over vertebra
Non-pregnant pressure	5	1	23	Pelvis very full	1.5	Filled	

Rabbit 5b. Replacement for Rabbit 5. Tag No. 86. White with grey legs and back. Plain plate previous to injection. *Non-pregnant.* An injection of 10 cubic centimeters diodrast was made into ear vein; injection time, 18 seconds. Plates were made at 18 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 5 minutes.

Non-pregnant, with pressure. The time of injection following first experiment is not recorded. The injection consisted of 10 cubic centimeters of diodrast into ear vein; injection time, 16 seconds. The plates were made at 16 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 5 minutes.

22 days pregnant. Injection of 10 cubic centimeters of diodrast into ear vein; injection time, 20 seconds. Plates made at 5, 10, 15, and 20 minutes. The best plate was obtained at 20 minutes.

22 days pregnant, with pressure. Again 10 cubic centimeters of diodrast was injected immediately into heart. The plates were made at 5, 10, 15, and 20 minutes. The best plate was obtained at 20 minutes.

SUMMARY OF EXPERIMENT, RABBIT 5A

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	5	1.5	44	Tapering	1.5	28	Tapering
Non-pregnant pressure	5	2.0	Filled	Shows well marked outward curve at brim	2.0	51	Faintly
Pregnant	20	1.0	Filled		2.0	Filled	
Pregnant pressure	20	2.5	Filled		1.5	Filled	Very fine ureter measurable only near pelvis

In this case, we doubt if there was effective application of the pressure apparatus in the pregnancy pressure test.

Rabbit 6. Black-grey belly and white shoulders and legs. Plain plate previous to injection. *Non-pregnant.* An injection of 10 cubic centimeters of diodrast was made into ear vein; injection time, 30 seconds. The plates were made at 30 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 1 minute.

Non-pregnant, with pressure. Reinjected at 1 hour and 49 minutes. Diodrast to the amount of 10 cubic centimeters was injected into the ear vein; injection time, 15 seconds. The plates were made at 15 seconds, 1, 2, 3, 4, and 5 minutes. The best plate was obtained at 3 minutes.

SUMMARY OF EXPERIMENT, RABBIT 6

	Low kidney				High kidney		
	Best plate min.	Diameter mm.	Filling mm.	Comment	Diameter mm.	Filling mm.	Comment
Non-pregnant	1	1.5	9.5		1.5	44	
Non-pregnant with pressure	3	1.5	Filled		1.5	53	Passed over top of 5th vertebra
21 days pregnant	15	2.0	59	None near bladder	1.5	27	
21 days pregnant pressure	10	1.0	Filled	Faintly	2.0	Filled	

Calyces very well filled in pregnancy pressure experiment.

21 days pregnant. Ten cubic centimeters of diodrast was injected into the ear vein; injection time, 20 seconds. The plates were made at 5, 10, 15, and 20 minutes. The best plate was obtained at 15 minutes.

21 days pregnant, with pressure. Interval from previous injection not recorded. Injection of 10 cubic centimeters of diodrast was made into the ear vein; injection time 8 minutes. The plates were made at 5, 10, 15, and 20 minutes. The best plate was obtained at 10 minutes.

CONCLUSIONS

1. Pregnancy changes in the urinary tract of animals, quadrupeds, cannot be expected to simulate pregnancy changes in women. The pressure factor is only slightly present in animals, if at all. Large ureteral dilatations are not to be expected in animals.

2. Ureteral dilatations have been recorded by veterinarians to be present in pregnancy in animals when stasis is produced through plugging of the ureters with blood, pus, and débris.

3. The effect of pregnancy in rabbits is to delay the appearance of the best plate after intravenous injection of diodrast and to fill the ureters considerably farther down toward the bladder than is seen in the non-pregnant animal.

4. Pressure, even when applied for short periods of time, influences the filling of the ureter and produces minor degrees of dilatation in pregnant rabbits. This modification of the physiology of the ureters is greater in the pregnant than the non-pregnant rabbit.

5. Rossi's contribution to the nature of the effect of pregnancy on the urinary tract in rabbits is worthy of support.

6. Present diametrically opposed views concerning the presence or absence of urinary tract changes in pregnancy in animals are based upon the erroneous concept that pelvic and ureteral dilatation in pregnancy in quadrupeds are the only indications of pregnancy change in the urinary tract which result from the pregnant state.

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THE ROENTGENOGRAPHIC DIAGNOSIS OF LIPOMA

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CLINICAL differentiation of lipomas from other soft tumors, cysts, and collections of fluid is often difficult and occasionally impossible by ordinary methods of physical examination. Cysts and collections of fluid can usually be definitely established by aspiration with a needle. Light is transilluminated more readily through clear cysts than through lipomas and much more readily through lipomas than other tumors of soft tissues. Deeply situated tumors give greatest difficulties in differentiation. Accurate differentiation between sarcoma and intramuscular lipoma is essential to allow intelligent planning of treatment. Extensive surgical resection is usually imperative in the case of sarcoma while operation is more or less a procedure of election in the case of lipoma. Biopsy by aspiration or by means of the biopsy punch is frequently, but by no means always, diagnostic.

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Fig. 1. G. G., aged 6 years. A tender, bulging mass of 3 months' duration in a child's foot was diagnosed as a sarcoma. The x-ray film shows a swelling in the medial plantar aspect of the soft tissues. It is composed of a central, ovoid, darkish radiolucent mass 2 by 3.5 centimeters, surrounded by a thin whitish layer of slightly greater density. This is diagnostic of lipoma which was found at operation. A correct diagnosis was not made due to lack of experience by the radiologist.

Roentgenographic examination will usually differentiate lipomas from other lesions due to the radiolucent appearance of fatty tumors in contrast with all other tumors. This radiolucent appearance results from the relatively lesser density of fat in comparison with the density of other soft tissues and tissue fluids. This fact is attested to by the common knowledge that fat floats on water while other tissues sink unless they contain air or gas. The relatively low density of fat results from a general constitution of $C_{20}H_{40}O_2$ which is relatively rich in hydrogen, the least dense of all elements. The proportionate constituents of protein are $C_{25}H_{40}N_7O_8S$ which contains relatively more of the heavier elements oxygen, nitrogen, carbon, and sulphur.

Other tumors which contain a large amount of fat or cholesterol also cast relatively radiolucent roentgenographic shadows. Liposarcomas of the abdomen show a remarkably low radiographic density when one considers their gross size. The borders of a liposarcoma are usually more poorly defined than the borders of a lipoma and the fat may be deposited in multiple lobules but biopsy is necessary for accurate differentiation. Dermoid cysts contain cholesterol and allied alcoholic esters in combination with various fatty acids and therefore produce a relatively radiolucent density as described by Odquist. Dermoids occasionally contain imperfect teeth which permits an accurate roentgenographic diagnosis in such cases. Xanthomatosis, whether in soft tissues or in bones, produces lesions of less than average soft tissue density. Calcification is frequent in fatty tumors, usually occurring in areas of impaired blood supply or infarction. It is brought about by the formation of calcium soaps and later deposition of calcium carbonate and calcium phosphate in the disintegrating tissues.

Cavities of organs or soft tissue pockets which contain gas or air are the most radiolucent areas demonstrated in roentgenograms

Fig. 2. Mr. F. S., aged 44 years. An ovoid, vaguely fluctuant submental mass showing gradual enlargement during 13 years was diagnosed clinically as a submental cyst. A roentgenographic diagnosis of lipoma was made on the basis of the submandibular ovoid, darkish, translucent area 2.5 by 6 centimeters, surrounded by a denser, whitish capsule and crossed by multiple fine trabeculations representing connective tissue septa. The roentgenographic diagnosis was confirmed at operation.

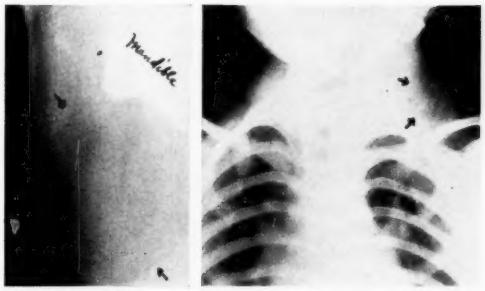

Fig. 3, left. Mr. J. C., aged 39 years. A soft, freely movable lump below the right jaw had shown recent growth to 7 by 9 by 12 centimeters, suggestive of cystic tumor of salivary gland or lipoma. The roentgenogram showed the tumor to be radiolucent and surrounded by a slightly denser capsule, thus establishing a diagnosis of lipoma which was confirmed at operation.

Fig. 4. J. J., aged 4 years. A soft, semifluctuant orange sized mass in left supraclavicular region was suggestive of hygroma or branchiogenic cyst. The x-ray film shows a relatively radiolucent tumor, having clear-cut borders and spotted by patches and strands of slightly greater density indicating a fibrolipoma which was removed at operation.

of the body. Differentiation from fatty tissues is made roentgenographically on the basis of the greater blackness of gas shadows, sharper margination, anatomical location, distribution in bubbles, and occasionally by associated fluid levels. Clinical observation will usually permit differentiation by history, compressibility, or crepitation.

Numerous authors have previously directed attention to the characteristic appearance of fatty tumors in the roentgenogram. Bufalini in 1925 was the first to point out the characteristic radiolucency of these tumors. Additional reports and observations have been contributed by Moriconi, Laurell, Schulte, Odquist, Tagliavacche and Casanovas, Reis, Chasin, and Templeton.

Laurell and Templeton have discussed the technical factors which are conducive to production of superior roentgenograms of fatty tumors. Soft tissue detail in small superficial

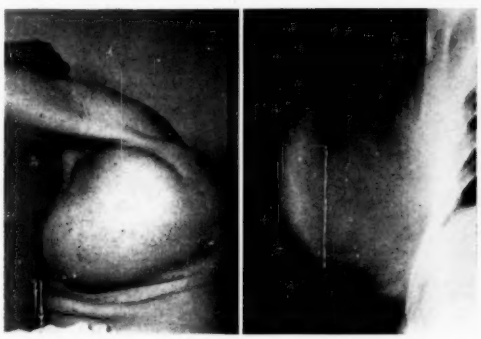

Fig. 5. Mr. H. W., aged 60 years. A recurrent, large firm slightly nodular tumor on the right chest wall was suggestive of lipoma or sarcoma. The x-ray film shows a rather sharply delimited relatively radiolucent mass, 15 by 20 centimeters, containing multiple small areas of calcification in its inferior portion. The roentgenographic diagnosis of lipoma was confirmed.

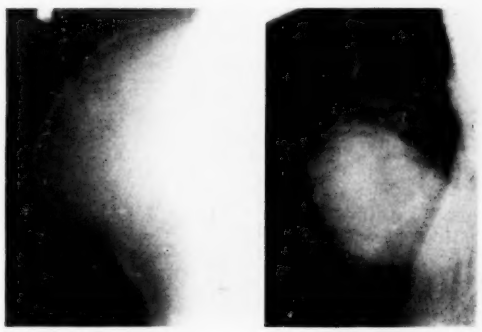

Fig. 6. Mr. S. S., aged 61 years. A firm, slightly irregular tumor in the right breast was thought to be lipoma, carcinoma, or sarcoma. A plain x-ray of the mass shows a fairly well circumscribed, ovoid, relatively translucent shadow 9 centimeters in size. Subcutaneous and perimammary injection of carbon dioxide accentuates demarcation but without the distinct encapsulation of a fibroadenoma. A lipoma was diagnosed and removed.

Fig. 7. Mrs. M. G., aged 59 years. An ovoid pendulous mass had gradually developed in right labia during 30 years. It had been diagnosed as hernia and repair was advised. The roentgenogram shows a well delimited, relatively radiolucent, somewhat lobulated mass, 8 by 12 centimeters, containing a few small areas of dense opacity. A diagnosis of lipoma with old areas of infarction and calcification was confirmed at operation.

lesions is favored by the use of cardboard film holders; low voltage, between 35 and 50 kilovolts; fine focal spot, preferably about 1 millimeter in size, and elimination of all motion during the exposure. In the examina-

Fig. 8. Mr. E. R., aged 64 years. A deep, non-tender, firm mass had developed in the lateral aspect of the right hip and buttock during 5 years. The roentgenogram shows a rounded, well circumscribed area of lesser density over the proximal femur warranting a diagnosis of lipoma. A lipoma was resected from between gluteal muscles.

a b c Fig. 10

Fig. 9

Fig. 9. Mrs. L. H., 56 years. Lobular, soft, freely movable masses, along lateral and medial aspect of right ankle, containing hard movable particles, suggested tenosynovitis and ganglion with "rice bodies." X-ray films show masses to be radiolucent, encapsulated, crossed by fibrous septa, and with areas of calcification. A diagnosis of lipoma was confirmed.

Fig. 10. Mrs. I. W., aged 68 years. The humerus had been previously saucerized and the wound packed with petrolatum. Roentgenograms made 3 months later show a rounded, well demarcated shadow of relatively lesser density to the right of the humerus. In the light of the history, this represents vaseline.

tion of regions over 8 centimeters in thickness, better contrast is obtained by the use of fine grained intensifying screens instead of cardboard film holders. The Potter-Bucky grid aids in the clarification of detail through regions over 12 centimeters in thickness.

SUMMARY

In a series of lipomas the clinical diagnosis was indeterminate while a positive diagnosis was possible on the roentgenograms. The rounded or ovoid radiolucent shadows cast by these tumors are pathognomonic of fatty tissue. Strands of increased density traversing the radiolucent mass represent septa and bands of fibrous connective tissue which vary in amount. Radiolucent soft tissue shadows are also cast by dermoids, xanthomas, liposarcomas, and aggregates of mineral or vegetable fats.

The differential clinical diagnosis in the case of the lipomas varies with the location. In the cervical region, one is led to consider thyroglossal cyst, branchiogenic cyst, hygroma, dermoid, salivary tumor, and sarcoma. In the breast, the possibilities of fibroadenoma, cystic mastitis, and carcinoma are presented. Along the extremities, tenosynovitis, sarcoma, hemangioma, and abscess may be suggested. In the scrotal or labial region, hydrocele or hernia may be simulated by the translucent bulging mass. Also to be considered occasionally in differential diagnosis are sebaceous cysts, meningoceles, von Recklinghausen's neurofibromas, and cold abscesses.

On the basis of our experience, we recommend roentgenographic examination as being an accurate procedure in the differential diagnosis of lipomas from other soft tissue tumors.

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Fig. 1. Site of anastomosis is indicated on gall bladder and jejunum.

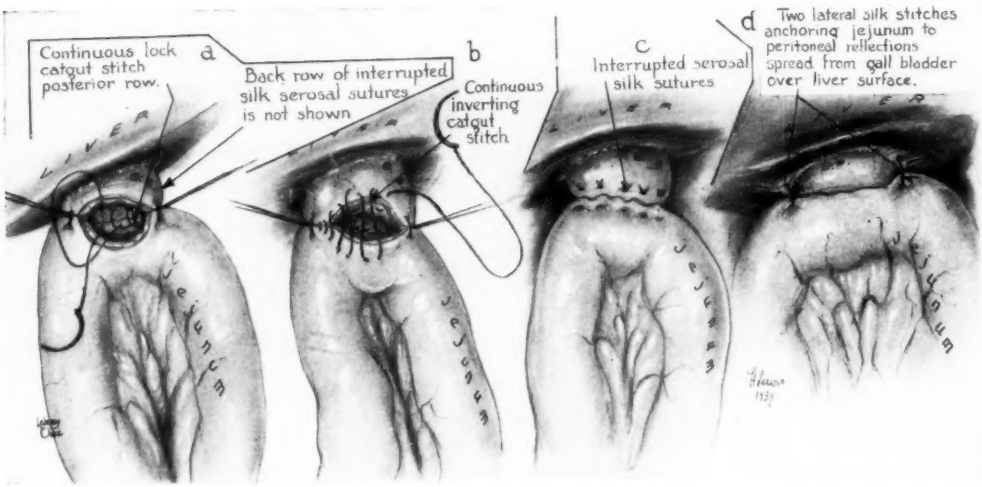
Continuous lock catgut stitch posterior row.
a
Back row of interrupted silk serosal sutures is not shown
b
Continuous inverting catgut stitch
C
Interrupted serosal silk sutures
d
Two lateral silk stitches anchoring jejunum to peritoneal reflections spread from gall bladder over liver surface.
LIVER
Jejunum

Fig. 2.

Cholecystjejunostomy.—Frank H. Lahey

CLINICAL SURGERY

CHOLECYSTJEJUNOSTOMY

As Opposed to Cholecystduodenostomy or Cholecystgastrostomy

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SOME years ago, in patients with obstructive jaundice due to carcinoma of the head of the pancreas or at the ampulla of Vater, I began the practice of anastomosing the gall bladder to the jejunum which was brought up over the colon at the hepatic flexure instead of performing cholecystgastrostomy or cholecystduodenostomy. This procedure has now been employed in a sufficient number of cases and over a sufficiently long period of time not only by myself but by the other surgeons in the clinic so that it may safely be presented as a method of sidetracking the bile from above the duct obstructed by malignancy into the intestinal tract. It is, at least in our hands, an operation which is easier to perform and one which is safer from the point of view of leakage than is anastomosis of the gall bladder to the stomach or anastomosis of the gall bladder to the duodenum.

There is an undesirable disproportion in the character of the thin walled distended gall bladder and the thick walled stomach with its heavy mucous rugæ at that portion of the stomach just proximal to the pylorus. Although bile introduced from the gall bladder directly into the stomach is well tolerated, as demonstrated by the number of cases in which this type of operation has been done, it is in general better to introduce the discharge of bile into the intestinal canal at some point beyond the pyloric sphincter. In re-operating upon patients who elsewhere had had the gall bladder anastomosed to the stomach we have several times seen the gall bladder and even the bile passages filled with gastric contents. While this feature of cholecystgastrostomy probably occurs only occasionally, nevertheless the fact that it does occasionally occur is disturbing and for this reason I began anastomosing the jejunum to the gall bladder.

The disadvantage of anastomosing the gall bladder to the duodenum is largely the danger of leakage because of its technical difficulties. In establishing an anastomosis between the gall bladder and the duodenum a water tight connection must be made between these two structures, one of which, the duodenum, is practically a fixed structure, and the other, the gall bladder and its attached liver, a more or less movable one, capable of considerable range of movement particularly when vomiting complicates the picture. While this motion probably puts but little strain on the suture line, it is not the most favorable state of affairs.

The greatest disadvantage of cholecystduodenostomy is the fact that with a deeply situated duodenum and with an overhanging right lobe of the liver, as is occasionally noted at operation the technical difficulties of an accurate introduction of anastomotic sutures between the deep gall bladder and the deep duodenum are considerable.

If the jejunum is anastomosed to the gall bladder in place of either the stomach or duodenum, all of the disadvantages mentioned are largely avoided. With a long loop of jejunum pulled up in front of the colon at the hepatic flexure and the distended gall bladder emptied of its bile by a suction trocar, the two lax viscera can be dealt with at the level of the abdominal wall and a very accurate suture line completed around the opening in the gall bladder and the jejunum. Following the anastomosis the attached jejunum may be so rotated that the back as well as the front suture line may be inspected and reinforced if there is any evidence of sutures cutting out in friable gall bladders.

When the anastomosis is completed, a separate stitch is passed through a point just outside the fundus of the anastomosed gall bladder where the peritoneal coat of the gall bladder spreads out over the under surface of the liver. This stitch, then, catches the jejunum just beyond the point where that structure is anastomosed to the gall bladder. A similar stitch is placed on the opposite side between the jejunum and this fold of peritoneum where it passes off the gall-bladder wall. By this

From the Department of Surgery, the Lahey Clinic.

plan, the jejunum is fixed to the liver and all tension on the suture line by the weight of the antecolic jejunum is removed. In addition, the jejunum is so fixed to the liver by these two suspension sutures that it ascends and descends freely with that structure.

We have had several patients with carcinoma of the head of the pancreas live 2 and 3 years following the employment of this procedure, long enough to determine that the discharge of bile into this level of the intestinal tract is apparently as satisfactory as at the duodenal level.

CONCLUSION

The plan here described of anastomosing the gall bladder to a high loop of jejunum in place of to the stomach or duodenum has been used over a sufficient period of time so that it may safely be recommended both from a technical and physiological point of view.

THE SURGICAL TREATMENT OF CHRONIC GASTRIC ULCER

Review of 272 Cases

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THE results of properly performed surgical procedures in selected cases of chronic benign gastric ulcer are so satisfactory and the risk of operation is relatively so small when performed by competent hands that there should be little hesitation in recommending surgical treatment for all gastric ulcers which fail to respond promptly to medical management. We have recently reviewed 272 consecutive cases of chronic gastric ulcer in which surgical treatment was carried out at the Mayo Clinic from January 1, 1933 to January 1, 1937. There were 220 men and 52 women in the group. These patients were followed for a period of 1 to 5 years after operation, and this report is based on the findings in these cases.

In any study of gastric ulcers, one is immediately impressed by the vast difference between these lesions and ulcers of the duodenum. It is unfortunate and confusing that the similarity of the symptom complex of gastric ulcer to that of duodenal ulcer has led to a linking of the two conditions under the common title "peptic ulcer." As one of us (Walters 13, 14) has pointed out repeatedly, the lesions are dissimilar as regards the type of tissue in which they occur, their pathological nature, their physiochemical activity, and their response to medical and surgical treatment.

INCIDENCE

Duodenal and gastric ulcers are the most frequent benign, surgical lesions of the gastrointestinal tract but, apparently, they occur less frequently in this country than abroad. Portis and Jaffé, as a result of 9,171 consecutive necropsies in this country, found the incidence of peptic ulcer to be 5.2 per cent; 196, or 2.9 per cent, were gastric and 158, or 2.3 per cent, were duodenal. Stewart, at Leeds, studied results from a series of 4,000 consecutive necropsies and found an incidence of 4.58 per cent of gastric ulcers and 6.81 per cent of duodenal ulcers. He estimated that more than 10 per cent of the population have peptic ulcer some time during life. The incidence of gastric and duodenal ulcer derived from studies at necropsy seems to be at considerable variance with the relative incidence of these lesions as found in living patients. According to Eusterman and Balfour at the Mayo Clinic, duodenal ulcer has been found about 10 times as frequently as gastric ulcer. Smithies, in a series of 1,725 cases of proved peptic ulcer, found 1,225 duodenal ulcers and 500 gastric ulcers, a proportion of 2.45 to 1.

Gastric ulcer is much more frequent among men than among women. According to Dibble, 72 per cent of gastric ulcers occur among men, 28 per cent among women. Smithies found the ratio to be about 2 to 1. In a clinical study, at the Mayo Clinic, the proportion of men to women was 3.9 to 1 and at necropsy, 3 to 1. In our series of 272 cases in which operation was performed, there were 220 men to 52 women, or a ratio of about 4.5 to 1.

SITE OF LESION

Most gastric ulcers are found along the lesser curvature in the vicinity of the angle of the stomach. In Stewart's extensive studies, 3.5 per cent of the lesions occurred on the gastric side of the pyloric canal, 22.4 per cent were 1 to 2 inches from the pylorus, 34.1 per cent were 2 to 3 inches from the pylorus, 29 per cent were 3 to 4 inches from the pylorus, and 10.6 per cent were more than 4 inches from the pylorus. In 116 of 196 cases, or 59.1 per cent, reported by Portis and Jaffé the gastric ulcers were within 6 centimeters of the pylorus, 49, or 25 per cent, were more than 6 centimeters from the pylorus and less than 3 centimeters from the cardia, 12, or 6.1 per cent, were in the fundus, 4, or 2 per cent, were on the anterior gastric wall, and 3, or 1.5 per cent, were on the greater curvature. The majority of the lesions in our present series occurred along the lesser curvature close to the angle of the stomach (Table I).

Gastric ulcer, like duodenal ulcer, is subject to perforation and hemorrhage. When perforation of a gastric ulcer occurs, it is usually into the gastrohepatic omentum or toward the capsule of the pancreas. Both of these structures form an anatomic base to the ulcer and when perforation occurs, this base usually prevents complete per-

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TABLE I.—SITE OF LESIONS (MAYO CLINIC SERIES)

Site	Men	Women	Totals	Per cent
Lesser curvature, above angle	65	19	84	30.9
Lesser curvature, at angle	86	12	98	36.0
Lesser curvature, below angle	32	11	43	15.8
Posterior wall	35	6	41	15.1
Greater curvature	2	2	4	1.5
Anterior wall	..	2	2	0.7
	220	52	272	100.0

foration with leakage of gastric contents into the peritoneal or lesser peritoneal cavity. Hemorrhage occurs not infrequently. Marshall and Kiefer found a history of hemorrhage in 11 per cent of their cases of gastric ulcer and in 18 per cent of their cases of duodenal ulcer. Smithies noted hemorrhage in 36.4 per cent of 500 cases of gastric ulcer. The hemorrhage was manifested by hematemesis in 80 per cent and by melena in 20 per cent. In our series, bleeding was manifest in 20 per cent of cases. Gastric ulcer, if in the prepyloric region, may produce obstruction similar to that produced by duodenal ulcer. Ulcers higher along the lesser curvature occasionally cause some obstruction due to reflex spasm of the pylorus. Occasionally gastric ulcer produces an hourglass stomach and this requires operation to relieve the obstruction produced between the fundus and antrum of the stomach.

The one major complication to which gastric ulcer is subject but to which duodenal ulcer is not subject is malignant changes. According to Stewart, gastric ulcers have a 10 per cent chance of becoming malignant. Smithies estimated that not more than 5 per cent become malignant; Lahey, 7 to 8 per cent; and Katsch, 20 per cent. Since, at present, there is no way of knowing which gastric ulcers are subject to malignant change or which small ulcerating carcinomas may simulate both symptomatically and roentgenographically a benign gastric lesion, we firmly believe that all gastric ulcers must be considered malignant until proved otherwise and they should be treated surgically if they fail to respond promptly to medical management.

The question of whether an ulcerating gastric lesion is a carcinomatous ulcer, a carcinoma or an ulcer, or a benign gastric ulcer, is one which too often cannot be determined by the examining clinician, the roentgenologist, or even the operating surgeon. Probably all gastric carcinomas begin as small lesions but we have no means of clinically determining when the malignant changes begin. In the early stages, when surgical treatment is most effective, all these ulcerating lesions of the stomach may give all the symptoms and signs of benign ulcer with none of the distinguishing characteristics of a malignant lesion. Not infrequently the borders or base of an ulcerating gastric lesion show carcinomatous changes, although there have been no suggestions of malignancy by clinical or roentgenologic or even surgical examination. Microscopic examination is required to determine definitely the nature of these lesions. Frequently it is impossible to determine otherwise whether the lesions are ulcerating carcinomas or carcinomatous ulcers and whether the ulcer or carcinoma is primary. That is not of prime importance, however. The fact remains that in patients in whom there is malignant change the treatment consists of wide excision of the lesion by partial gastrectomy.

INDICATIONS FOR OPERATION

When the symptoms have been of short duration, the lesion small and uncomplicated, and the patient less than 40 years of age, medical management as suggested by Eusterman, Jordan, and others may be indicated. If the pain is relieved, the blood disappears from the stool, and the niche seen on roentgenologic examination disappears, the patient may be considered to have a benign ulcer. However, even if the lesion does appear to be healing satisfactorily, the patient must be advised to continue medical management at home and to undergo re-examination at least every 3 months; the examination should include careful roentgenoscopic examination of the gastric mucosa in every case. This should be supplemented with gastroscopic studies when possible. If, at any time, there is any evidence that the lesion has not remained completely healed, surgical exploration should be advised. As McVicar has pointed out, one must constantly be on guard not to be led astray by temporary beneficial response to medical management, since small ulcerating malignant lesions may temporarily show signs of healing both clinically and roentgenologically.

The value of repeated careful roentgenoscopic examination of the stomach in cases of gastric ulcer cannot be overemphasized. However, the limitations of this diagnostic procedure must be recognized. A definite roentgenologic diagnosis of malignancy usually proves to be correct but all roentgenologists agree that it is impossible roentgenologically to determine the benignancy or malignancy of the small ulcerating lesions of the stomach. It is enough that roentgenologic examination can determine the presence and site of lesions and, on repeated examinations, any changes in their size and character. Although the size and character of such lesions are subject to

considerable variability (one of us, Walters, has seen gastric ulcers appear to change in size, as noted by comparing films over a period of 24 hours), such changes actually are not possible anatomically in so short a time. To depend on the roentgenogram for more than this will lead to a definite incidence of error in diagnosis; a lesion may appear to be a benign ulcer and yet be a cancer and the opportunity for cure may be lost due to the delay in recognizing its true nature.

As Moersch and Snell have pointed out, the use of the gastroscope in the diagnosis of gastric ulcer must assume a place secondary to roentgenologic examination. However, roentgenologic diagnosis is not infallible and gastroscopy should always be considered in patients in whom the clinical history is suggestive of a gastric lesion although the roentgenologic examination does not reveal any abnormality. Although the accuracy of roentgenologic diagnosis of lesions of the stomach is remarkably high, there is always a chance that a small lesion or one situated high in the stomach may be overlooked. Gastroscopy is also of considerable value in distinguishing between a benign gastric ulcer and a malignant ulcer and may offer valuable information as to the operability of the lesion. Gastroscopy is also a valuable aid in determining the effect of medical management on gastric ulcers. We do not feel that gastroscopy should be necessarily a routine procedure in all gastric examinations, but we have found it to be a very valuable adjunct to clinical and roentgenologic study of selected cases of known and suspected gastric disease.

Surgical treatment of chronic gastric ulcer is almost always indicated if the symptoms have been of long duration or have not responded to adequate medical management. Likewise, operation may be indicated if the symptoms are severe and disabling, even if of short duration. The same indications for surgical intervention in cases of bleeding, perforating, and obstructing gastric ulcers hold true as for similar duodenal lesions.

Because of our inability definitely to determine clinically or roentgenologically the malignancy or benignancy particularly of small ulcerating gastric lesions and because the surgical treatment is so satisfactory, we feel that operation is indicated in most cases of gastric ulcer if a trial course of medical treatment has been unsuccessful.

OPERATIVE PROCEDURES

The ideal surgical procedure for chronic gastric ulcer is one which removes the lesion, eliminates pylorospasm, and alters gastric physiology to produce a marked reduction of gastric acidity, thus protecting against recurrence of ulceration. This is usually possible either by resection of the stomach or by excision of the lesion combined with gastro-enterostomy. However, other procedures such as simple excision of the ulcer or gastro-enterostomy have been followed by excellent results in selected cases. The operative procedures used on our series of cases are noted in Table II. Posterior Pólya resection was the operation used most frequently, 131 of the 272 patients having been treated in this manner. Knife or cautery excision of the lesion combined with gastro-enterostomy was used in 50 cases. Other procedures were used much less frequently but in some cases were used to good advantage when resection or excision and gastro-enterostomy were not feasible.

TABLE II.—SURGICAL PROCEDURES USED IN THIS SERIES

	Totals
Excision of ulcer	14
Sleeve resection	10
Closure, acute perforation	3
Anterior gastro-enterostomy and entero-enterostomy	5
Anterior Pólya-Balfour (partial gastrectomy)	9
Excision and pyloroplasty	9
Excision and gastro-enterostomy	50
Posterior gastro-enterostomy	16
Billroth I (partial gastrectomy)	22
Posterior Pólya (partial gastrectomy)	131
Total gastrectomy	1
Gastrogastrostomy	1
Exploration	1
	272

Simple excision of a gastric ulcer, although not an ideal surgical procedure because it does not provide for alteration of gastric function and gastric acidity necessary to prevent recurrence of ulceration, is frequently followed by surprisingly good results. Excision may be indicated occasionally if it can be done without interfering with normal peristalsis, and if the patient's general condition will not permit a more extensive operation. This procedure was performed 14 times in this series, cautery was used 5 times, and the knife, 9 times. The results were satisfactory. The average gain in this group was 15 pounds. One patient continued to have moderate distress of the ulcer type after operation and she believed that she had had one small hemorrhage. Eight of these patients experienced excellent results and 5 did not answer the questionnaire. Apparently, the procedure gives good results in selected cases; but we do not recommend it as a routine procedure.

Segmental or sleeve resection of the segment of the stomach in which the lesion is situated, with restoration of gastric continuity appears logical, for it removes the lesion with the least possible anatomic change. The disturbance of gastric peristalsis and lack of protection from subsequent ulceration, however, make this operation less satisfactory than some others, in most instances. The procedure was performed 10 times in our series. The average gain was 20 pounds. Five patients were perfectly well without distress of any kind, 4 occasionally had slight distress, and only 1 had to follow a careful dietary regimen to prevent distress. We recently operated on a doctor who had the largest gastric ulcer we have ever seen. It had recurred after a sleeve resection, performed elsewhere, and had perforated with a crater base on the pancreas and on the undersurface of the liver, making a mass 10 centimeters in diameter.

Gastro-enterostomy alone is not the operation of choice for gastric ulcer, for by this procedure alone the lesion is not removed and one is still confronted by the possibility that the lesion may be malignant. The procedure may be indicated for large perforating lesions of the stomach when the patient's condition or age or the high position of the ulcer does not warrant a more extensive procedure. Gastro-enterostomy, both anterior and posterior types, was carried out 21 times. Fourteen of these patients reported excellent health without distress of consequence and only 1 reported occasional, mild distress. There was no report from 5 of the group. There was 1 death. The average gain was 15 pounds.

Excision by cautery or knife combined with gastro-enterostomy is a very satisfactory procedure, for it removes the lesion and modifies gastric motility and secretory function and can be performed at very low risk. The lesion must be sufficiently small to lend itself readily to excision without encroachment on the pylorus. If conditions are such that excision combined with gastro-enterostomy is a formidable procedure, a resection is often preferable. Excision of the lesion with gastro-enterostomy was carried out on 50 patients. Twenty-nine answered the questionnaire. The average gain was 12 pounds. Twenty-seven were in excellent health, 1 had mild recurring distress, and the condition of another was only partially improved.

The operation which, in the greatest number of cases, most satisfactorily accomplished removal of the lesion and reduction of gastric acidity with maximal protection against recurrence of ulceration was gastric resection of the Pólya or Pólya-Balfour type. This procedure is preferable unless the lesion is so high that resection above the lesion is not technically feasible or if the condition of the patient is not good enough to stand such a formidable procedure. In our present series, the posterior Pólya resection was performed 131 times and the anterior Pólya-Balfour, 9 times. The results were extremely satisfactory. Eighty-five patients responded to the questionnaire. There was an average gain of 13 pounds. Eighty patients were in excellent health without distress. Five were in very good health with only occasional, slight distress. There were 9 deaths in this group.

The Billroth I resection is a very satisfactory procedure if the gastric ulcer involves the pyloric third of the stomach and if resection can be performed with approximation of the stomach and duodenum without tension. Assisting in the performance of the operation, is a mobile duodenum. This procedure was performed 22 times in the series. There were 4 deaths in this group. Nine patients did not answer the questionnaire, 6 obtained very satisfactory results, and 3 continued to have slight distress. The average gain was 15 pounds.

In general, plastic operations on the pylorus with excision of the gastric ulcer do not give as good results as partial gastrectomy or excision of the ulcer and gastro-enterostomy, because the former procedure does not sufficiently hasten the emptying of the stomach or produce the desirable degree of reduction of gastric acidity. The procedure may be advisable if the lesion is on the anterior wall of the stomach just proximal to the pylorus, in which case excision and pyloroplasty may give satisfactory results. This operation was performed upon 9 patients in this series. Four obtained very satisfactory results; 5 did not reply to the questionnaire.

Total gastrectomy was performed upon 1 patient in whom a very high ulcer appeared to be malignant. Gastrogastrostomy was performed once; closure of perforated ulcer, 3 times; and exploration, in only 1 case. There were only 16 deaths (15 men and 1 woman) in this series of 272 cases of surgically treated gastric ulcer, a mortality of 5.88 per cent. The average age of the patients who died was 59 years. Pneumonia presents the greatest hazard to these patients. Ten of the 16 deaths in this series were due to pneumonia. In the past year, however, postoperative pneumonia has become a much less serious problem in these cases, for in sulfapyridine with and without oxygen and serum therapy we have found therapeutic agents that have decreased materially

the mortality from postoperative pneumonia and we believe still further decreases in the dangers and seriousness of this complication will occur. There was 1 death due to coronary occlusion, a hazard beyond our control, and 1 due to pulmonary embolus. One death was attributed to peritonitis, 1 to duodenal fistula, and 2 to hemorrhage.

RESULTS OF SURGICAL PROCEDURES FOR CHRONIC GASTRIC ULCER

Follow-up of these 272 cases of gastric ulcer was carried out by correspondence and the results were evaluated by the response to these letters. All the patients in this series had been operated upon from 1 to 5 years previously. It is interesting to note that only 1 patient in the entire group of 162 who answered the questionnaires classified himself as having a poor or unsatisfactory result. This patient had had a simple excision of the ulcer, a procedure we do not recommend.

The satisfactory results from the various types of procedures were approximately equal. This indicates that best results can be obtained by the use of a variety of surgical procedures, thus fitting the operation to the patient rather than the patient to the operation. It is also gratifying to note the excellent gain in weight and improvement in the general health of almost all of the patients. Gastro-enterostomy without excision of the gastric ulcer seemed to give the least satisfactory results in our series. However, as we have pointed out previously, on some occasions no other procedure is advisable or technically feasible.

In the entire series there was only 1 case of possible bleeding following operation and no cases of gastrojejunal ulcer were definitely proved following any of the procedures performed; however, as already noted, some patients in each group had some mild distress, at times.

This review shows clearly that the results of a properly chosen and properly performed operation for benign gastric ulcer are some of the best in the field of surgery and that disturbing symptoms or recurrence of ulceration is seldom encountered following operation.

SUMMARY

A series of 272 cases of chronic gastric ulcer in which surgical treatment was employed have been reviewed and the results have been analyzed. The results of surgical treatment of chronic gastric ulcer are among the best in the field of surgery. Partial gastrectomy is the treatment of choice, but on proper indications, a variety of surgical procedures will give good results. Surgical treatment of gastric ulcer is indicated in any case in which response to a carefully controlled medical management fails to occur.

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IDIOPATHIC SEGMENTAL INFARCTION OF THE GREATER OMENTUM

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INFARCTS which occur within a localized segment of the greater omentum, because of their exceedingly uncommon occurrence, are looked upon as unique surgical lesions. A search of the literature reveals the infrequency with which these lesions have been observed, diagnosed, and reported. Because of this rarity it seemed worth while to report a group of 6 consecutive patients from the Jewish Hospital who had omental infarcts and who were operated upon during the period from 1915 to 1939, all of whom recovered. Some of the theories which have been advanced to explain the etiology and pathogenesis of omental infarcts, also will be described and discussed. To do this satisfactorily one must have an accurate understanding of the anatomy and physiology of the omentum; the structure and function of this organ as it concerns the present paper will first be reviewed.

Cunningham describes the greater omentum as a large apronlike fold of peritoneum, usually more or less loaded with fat, which is suspended from the transverse colon and hangs down in front of the intestines to a variable extent. When the abdomen is opened without disturbing the viscera, it is rare to find the greater omentum evenly spread over the front of the intestines. Most commonly it is folded in between some of the coils of intestine, or tucked into the left hypochondrium; or perhaps it is carried upward in front of the stomach by the distended transverse colon.

Numerous functions have been assigned to the great omentum; the chief seem to be: (1) to act as a movable and easily adjustable packing material, capable of filling all temporarily produced spaces in the abdomen; (2) to serve as a storehouse for fat; (3) to be the "great protector against peritoneal infectious invasions." Because it is freely movable it can travel to almost any part of the abdomen, and there build up barriers of exudate to check infections. It is because of this last property that it is often involved in many of the morbid changes which affect the intraperitoneal organs. In this way, for example, either a portion or the entire omentum may become the seat of inflammatory, vascular, or neoplastic changes. Primary lesions of the omentum, on the other hand, are relatively rare. A survey of the literature reveals only 2 cases of primary thrombosis of the omental venous system. Furthermore, the 2 cases cited are in reality not true instances of primary omental infarcts. In 1 case the entire portal venous system was involved and in the other, congestive heart failure appeared to be the underlying causative agent of the omental infarct.

The case reported by Hines concerns a 54 year old male, who complained of generalized abdominal pains of 2 weeks' duration. The only positive finding on examination was a tender mass in the left upper quadrant, which at operation was seen to consist of omentum which contained multiple venous thrombi. The patient died of generalized peritonitis and at necropsy the superior mesenteric and splenic veins were found to be thrombosed, and the omentum was found to be the seat of numerous hemorrhagic infarcts. The second case in the literature is one reported by Berger. It concerns a 53 year old white male, who was known to have arteriosclerotic, hypertensive, syphilitic, cardiac disease for a number of years. The patient was admitted to the hospital during his second attack of congestive heart failure. At the time of his entrance he complained of severe sticking pains in the left upper abdomen. On examination, the only objective finding was skin hyperesthesia; a clinical diagnosis of infarct of the spleen was made. The patient died 48 hours after entrance to the hospital. At necropsy, the left third of the omentum was thickened, lusterless, and of a purple discoloration. A branch of the left gastroepiploic vein was found thrombosed; the arteries were normal. There was, in addition, chronic passive congestion of the viscera and a small infarct of the spleen. The left ventricle of the heart contained a mural thrombus superimposed on a large healed infarct of the wall of the ventricle. Microscopically, the omentum was the seat of extensive hemorrhages associated with an inflammatory reaction. The veins were occluded by thrombi composed chiefly of platelets, marginated leucocytes, and conglutinated red blood cells.

The cases reported in this paper differ from those cited by Hines and Berger in that the infarct was confined to a small segment of the greater

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omentum. This was caused by a thrombus which caused occlusion of the vein draining the infarcted area. The condition appeared rather suddenly in individuals who were otherwise known to be healthy.

CASE 1. I. S., a 63 year old male, was admitted to the hospital because of abdominal pain and constipation of 6 days' duration, and vomiting of 3 days' duration. The pain at the onset was diffuse and generalized over the entire abdomen, intermittent, and colic-like in character. Three days later the pain localized in the right lower quadrant of the abdomen, became severe and more persistent, and was associated with vomiting of gastric contents. There was no bowel evacuation during all this time, and enemas were ineffectual. There was no history of any previous abdominal complaint, operation, or injury.

On physical examination the patient appeared to be well developed and well nourished. He was lying on his back with thighs flexed and was moaning with pain. There was a moderate degree of abdominal distention, and exquisite tenderness, muscle spasm, and rigidity in the right lower quadrant. The temperature was 99.4 degrees F., pulse 100, respirations 24, and blood pressure 160/95. The urine showed a faint trace of albumin, occasional white blood cells, and hyaline casts. The blood count revealed 12,400 white blood cells, 81 per cent of which consisted of polymorphonuclear leucocytes and 19 per cent lymphocytes.

The clinical impression was that of acute appendicitis for which he was operated upon through a right midrectus incision. As the peritoneal cavity was opened, a mass of black, gangrenous omentum came into view. The latter measured 8 by 12 centimeters, and was situated in the distal end of the greater omentum. Careful exploration of the peritoneal cavity failed to reveal any other pathological changes. A resection of the gangrenous segment was done and recovery was uneventful.

Grossly, the resected portion of omentum consisted of a hemorrhagic mass of fatty tissue; it measured 8 by 12 centimeters. On section, it was found to contain numerous small extravasations of blood and thrombosed blood vessels. Microscopic examination of the specimen revealed an infarct of the omentum caused by thrombotic occlusion of its venous return.

CASE 2. L. W., a 53 year old female, was admitted to the hospital with the complaint of constant, severe, burning pain in the right lower quadrant of the abdomen of 4 days' duration. The patient had experienced occasional intermittent but mild burning pains in the same area 6 months prior to the present admission. Her past history was irrelevant; she was an octipara and menopause occurred 2½ years ago.

On examination, the patient was found to be a well nourished woman who was lying comfortably in bed. The temperature was 99.8 degrees F., pulse 78, respirations 24, and blood pressure normal. The mouth was edentulous and the tongue was coated. The abdomen was very tender and spastic over McBurney's point. The urine was normal; the blood count showed 10,000 white blood cells, and the differential count showed 82 per cent polymorphonuclear leucocytes and 18 per cent lymphocytes.

The clinical impression was that of acute appendicitis. At operation, through a right gridiron incision under spinal anesthesia, the peritoneum was opened and a quantity of free serosanguineous fluid was found in the peritoneal cavity. Adjoining the abdominal wound and adherent to the parietal peritoneum by a few fresh fibrinous shreds, was a small segment of the distal portion of the omentum. The latter measured 5 centimeters in diameter, was gangrenous and of a blue black color; the appendix was normal. Excision of the discolored omental segment was followed by uneventful recovery. There was no pathological report of the specimen.

CASE 3. H. R., a 40 year old male, was admitted to the hospital with the complaint of pain in the right lower quadrant of the abdomen of 4 days' duration. The pain was sharp, persistent, and non-radiating. Since the onset of his illness the patient had been constipated and enemas were ineffectual.

On examination, the patient appeared to be well nourished and was lying quietly in bed. The temperature was 100.6 degrees F., pulse 100, respirations 24. The only positive finding was exquisite tenderness and muscle spasm over McBurney's point. The urine examination and blood Wassermann were negative. The blood count showed 18,000 white blood cells, of which 83 per cent were polymorphonuclear leucocytes and 17 per cent were lymphocytes. The clinical impression was that of acute appendicitis.

At operation, through a right gridiron incision under general anesthesia, a mass of infarcted and inflamed omentum was found which was loosely adherent to the parietal peritoneum. The appendix appeared normal. Appendectomy and excision of the infarcted portion of the omentum was performed and recovery was uneventful. Pathological examination of the segment of omentum showed a hemorrhagic infarct caused by thrombotic occlusion of its venous system.

CASE 4. A. D., a 52 year old male, was admitted to the hospital with the complaint of pain in the right lower quadrant of the abdomen of 2 days' duration and constipation of 6 days' duration; enemas were ineffectual. The pain was constant, dull, and non-radiating. On the day of admission the pain became more severe and was exaggerated by any attempt at motion, coughing, or straining. There was no history of previous operation or trauma. In the past, the patient had always been well except for periods of constipation. Nine years before the onset of his present illness he was said to have had Buerger's disease. Following a slight trauma to his left foot the patient manifested symptoms of vascular disease of the lower extremities. After a 3 year period of complete disability, a portion of the left hallux became gangrenous and a spontaneous amputation of the distal third of the large toe occurred. Since then the patient has been completely free of symptoms.

Examination revealed a well developed, obese male who was lying quietly in bed. The temperature was 99.4 degrees F., pulse 90, respirations 22, and blood pressure 130/85. The essential physical findings consisted of slight abdominal distention, marked tenderness over McBurney's point, considerable local hyperesthesia, and a suggestion of muscle spasm in the right lower quadrant. The terminal portion of the left big toe was absent and a healed scar indicated the site of the amputation. There was no other finding indicative of a vascular disturbance in the extremities. The urine was normal. There was 13,500 leucocytes, 71 per cent of which consisted of polymorphonuclear leucocytes and 29 per cent of lymphocytes. A flat plate of the abdomen showed merely gaseous distention of the large bowel. The pre-operative diagnosis was acute appendicitis.

At operation, through a right midrectus incision under spinal anesthesia, a small amount of free serosanguineous fluid was found in the peritoneal cavity. The appendix appeared small and fibrotic. Adjoining the abdominal wound there was found a mass of gangrenous omentum loosely adherent to the anterior parietal peritoneum. Careful examination of the abdominal cavity failed to reveal any other pathological changes. Appendectomy and excision of the involved portion of omentum was done and the patient made an uneventful recovery.

TABLE I.—SUMMARY OF CASES

Case No.	1	2	3	4	5	6
Age	63	53	40	52	37	47
Sex	M	F	M	M	M	F
Duration of symptoms, days	6	4	4	2	2	3
Pain at start	Diffuse R.L.Q.*	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.	Localized R.L.Q.
Tenderness	Yes	Yes	Yes	Yes	Yes	Yes
Rigidity	Yes	Yes	Yes	Yes	No	Yes
Vomiting	Yes	No	No	No	Yes	No
Constipation	Yes	No	Yes	No	Yes	No
Temperature, degrees F.	99.4	99.8	100.6	99.4	99.6	99.8
Distention	Yes	No	No	Yes	No	Yes
W.B.C.	12,400	10,000	18,000	13,500	9,800	9,000
Pre-operative diagnosis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis	Acute appendicitis
Postoperative diagnosis	Infarct of omentum	Infarct of omentum	Infarct of omentum	Infarct of omentum	Infarct of omentum	Infarct of omentum

*R.L.Q., right lower quadrant.

Grossly, the excised portion of omentum consisted of an irregular mass of red and black, yellow, adipose tissue, measuring 7 by 4.5 by 1.5 centimeters. The surface was covered by prominent blood vessels. The cut surface was mottled dark blue and black; the consistency was firm.

Microscopically, there were found numerous engorged blood vessels and extravasated blood. Some areas were infiltrated with small and large monocytes and polymorphonuclear leucocytes. The appendix showed mild involutionary changes.

CASE 5. P. O., a 37 year old male, was admitted to the hospital with the complaint of pain in the right lower quadrant and vomiting of 48 hours' duration. The pain was sharp and constant and grew progressively worse in character. There was no history of any previous abdominal disturbance, operation, or injury. His health in the past had been excellent.

Examination revealed an obese male who was lying in bed with the thighs flexed on the abdomen with marked tenderness in the right lower quadrant of the abdomen and immediately around the umbilicus. The temperature was 99.6 degrees F., pulse 100, and respirations 22. The urine was negative. The white blood cell count was 9,000; the differential count showed 75 per cent polymorphonuclear leucocytes and 25 per cent lymphocytes. A diagnosis of acute appendicitis was made.

At operation, through a McBurney incision under spinal anesthesia, a quantity of serosanguineous fluid was found in the peritoneal cavity. The appendix was bound down in the right iliac fossa. The free border of the omentum showed an area of gangrene. An appendectomy with excision of the gangrenous portion of omentum was done; recovery was uneventful.

Grossly, the excised portion of omentum measured 3 by 4 centimeters in size. It was of a deep red color and leading to it was a thrombosed blood vessel. Microscopically, it showed diffuse hemorrhagic extravasations and the veins occluded with fresh thrombi. The appendix was essentially normal.

CASE 6. A. C., a 47 year old female, entered the hospital with the complaint of pain in the right lower quadrant of the abdomen of 3 days' duration. The pain was sharp and was aggravated by the ingestion of food. There was no history of any previous abdominal disturbance, operation, or injury. Menses were normal. She was an octipara and had had two miscarriages.

On examination, the patient was found to be a well developed and nourished woman. The abdomen was distended. There was tenderness and rigidity in the right lower quadrant. The temperature was 99.8 degrees F., pulse 90, and respirations 25. Urine findings and blood count were normal. A diagnosis of acute appendicitis was made.

At operation, through a right midrectus incision, a portion of the greater omentum was found discolored red and blue and adherent to the parietal peritoneum. A thrombosed vein was found at its free edge; the appendix appeared normal. An appendectomy and resection of the discolored portion of omentum was done. The patient made an uneventful recovery.

Grossly, the appendix was normal. The omentum measured 2 by 2 by 0.5 centimeters. It was firm and red and black in color. Microscopically, it showed hemorrhagic extravasation and venous thrombosis.

Of the 6 cases reported in this paper, 4 were males and 2 were females. The ages of the patients in this series ranged from 37 to 63, with an average age of 48.6 years. The onset of symptoms was acute in all 6 patients; in only 1 instance was there a history of occasional slight burning pain in the right lower quadrant of the abdomen for a period of 6 months preceding the acute onset. The average duration of symptoms before operation varied from 3 to 7 days. Pain localized in the right lower quadrant was the most outstanding symptom in all cases. In 1 instance the pain in the right lower abdomen was preceded by generalized abdominal pains.

The character of the pain varied; it was described as cramplike by 1 patient, sharp by 3,

burning by 1, and dull, followed by sharp exacerbation shortly before operation, by another. The pain was intermittent in 1 patient and constant in all the others. Motion, coughing, and straining aggravated the symptoms in 2 instances and the intake of food in 1. Nausea and vomiting were present in 2 patients and constipation was a prominent symptom in 3 patients. None of the patients presented an antecedent history of an intra-abdominal operation or trauma.

Physical examination, in all 6 patients revealed well developed and well nourished individuals; 2 were obese. The average temperature varied from 99.6 to 99.8 degrees F.; in 1 instance it was 100.6. Three patients showed exquisite local abdominal tenderness and skin hyperesthesia, while the 3 remaining showed a lesser degree of tenderness. In 3 of the patients there was found local rigidity of the abdominal wall; 2 had muscle spasm in the right lower quadrant, and in 3 others distention was present.

The white blood cell count was normal in 2 patients; in the others it was elevated and ranged between 10,000 and 18,000 per cubic millimeter. The differential count showed 71 to 83 per cent polymorphonuclear leucocytes and the remainder were lymphocytes.

The pre-operative diagnosis in all 6 patients was acute appendicitis. At operation, 3 patients showed serosanguineous fluid in the peritoneal cavity. There was a striking similarity in the pathological picture all 6 patients presented; it consisted of a hemorrhagic infarct involving a small segment of the terminal portion of the right side of the omentum. The infarcted area varied in size measuring 3 by 4 centimeters to 8 by 12 centimeters. In 4 instances the affected portion of omentum was adherent to the anterior parietal peritoneum by a plastic exudate. The infarcted omentum presented itself at operation as a blue, red, and black mass, markedly thickened and firm in consistency, and sharply demarcated from the surrounding omental tissue. The veins were prominent and in 3 instances there was macroscopic evidence of thrombosis of the veins in the infarcted omentum (Fig. 1).

Microscopic examination of the specimens again showed the same histological picture in all patients. It consisted of congestion and thrombosis of the venous channels, and hemorrhagic extravasations into the omental fat. The thrombi were relatively fresh and consisted largely of platelets, marginated white blood cells, and agglutinated erythrocytes. There was, in addition, a mild inflammatory reaction, in which the exudate consisted for the most part of small and large mono-

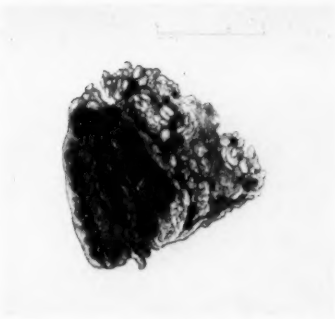

Fig. 1. Photograph of hemorrhagic infarct in segment of omentum. Note the sharply demarcated area of infarction from the surrounding omental fat.

cytes, polymorphonuclear leucocytes, and plasma cells. In 2 instances there were also found numerous lipophages; the latter varied considerably in size and some averaged as much as 20 times the size of a normal leucocyte. The lipophages were round, polygonal, or oval in shape; the cytoplasm was pale and finely granular and the nucleus was relatively small and round. Some of the cells contained more than one nucleus. These cells resembled very closely in appearance the so called "pseudo-xanthomatous" or foam cells. Scattered between these cells were congested capillaries and a variable number of polymorphonuclear leucocytes (Figs. 2 and 3).

In a general way, it may be said that the symptoms of omental infarcts mimic those of acute appendicitis. Pain in the right lower quadrant of the abdomen is more or less a constant feature, and is described as sharp, colicky, and burning in character. Another striking symptom in the syndrome of this disease is the disproportion between abdominal tenderness, the duration of symptoms, and abdominal rigidity. The abdomen is usually widely and definitely tender to deep palpation and the abdominal rigidity is not nearly as marked as one might expect it to be when the possible duration of the complaint and definite tenderness are considered. Another outstanding symptom of this disease is the very marked hyperesthesia of the skin which is not commonly seen in other acute intra-abdominal lesions. The normal leucocytic relationship is only moderately disturbed. The temperature range in the uncomplicated picture is low. Unless the possibility of this condition is kept in mind it will be very difficult to recognize it as a definite surgical problem, although surgery offers a very excellent prognosis. Appendicitis is perhaps the disease most likely to be con-

Fig. 2. Omental infarct, showing a section of a vein, the lumen of which is obliterated by a thrombotic mass, and the surrounding omental fat diffusely infiltrated with hemorrhagic extravasations and some round cell infiltration. ×85.

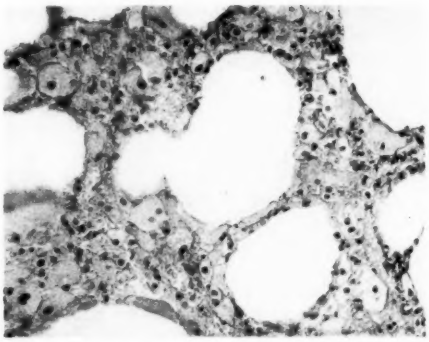

Fig. 3. Infarct of the omentum showing infiltration of the tissues with large foam cells or microphages. ×225.

fused with infarction of the greater omentum. The changes enumerated herewith are so constant and typical as to form that if not a clinical, at least a pathological entity is always suggestive.

EVALUATION

Many and varied suggestions have been offered to explain the etiology of omental infarcts. All investigators agree that the necrosis of tissues follows strictly in the path of, and is confined to, the thrombosed vascular areas. In regard to the immediate mechanism of this thrombosis, there is no uniformity of opinion. In a general way, it may be said that more than any one causative factor may be responsible for the production of local thrombosis in individual cases. It would be of interest in this connection to enumerate the various conditions under which local thrombosis may develop in the omental veins.

Thrombi may be liberated from some distant point into the general circulation and later become arrested in an omental vein as an embolus. Such a condition, however, is unlikely to occur, unless one assumes the presence of an arteriovenous aneurism of the omental vessels. Moreover, there was no evidence in any of the cases here cited of a lesion existing elsewhere in the body from which thrombi might become detached.

One of the patients whose case is cited in this paper (Case 4) was said to have had thromboangiitis obliterans of the lower extremities, which was followed by spontaneous amputation of the toe several years previous to the development of the omental infarct. Since Constantinesco has reported cases of mesenteric thrombosis and infarction which followed on the heels of thromboangiitis obliterans, it was felt at first that the thrombosis of the omentum in our case might be explained on a similar mechanism. However, pathological examination of the specimen showed no evidence of an existing thrombo-angiitis of the epiploic veins. Such a hypothesis, therefore, may be completely disregarded as it concerns the present case.

Venous thrombosis in torsion of the omentum is a well recognized entity (4, 6). The condition is caused by a sudden twisting of the omentum that results in acute circulatory disturbances. If the twist is not reduced immediately the structures distal to the lesion become gangrenous. If infection does not supervene, the aseptic gangrene is subsequently organized into a mass of fibrous tissue that leads to complete disappearance of the involved omental tissue. This explanation, especially as it concerns this series of cases, is open to question. None of the patients in the series described herewith showed at operation any evidence of a twist in the omentum. Furthermore, the infarct was situated in a portion of the omentum where torsion does not occur because of mechanical conditions.

In a series of experiments conducted by one of us (8), it was shown that a forceful pull on the jugular vein in the rabbit which injured its endothelial lining, resulted in the formation of a clot at the site of the injury. Furthermore, if the lumen of the vein distal to the point of injury was partially constricted so as to retard the flow of blood through the vein, thrombosis occurred more promptly. There was a striking resemblance in the character of the thrombus thus produced experimentally to that seen in the infarcted omentum. Both types of thrombi were composed of platelets, marginated leucocytes, and agglutinated

red blood cells. In the light of such experimental findings it is the authors' belief that the mechanism involved in the formation of omental thrombi is similar to that which is produced experimentally. We believe that a possible stretching of an omental vein may occur consequent to some trauma, and this in turn leads to the formation of a thrombus.

It is of interest to note in this connection some of the experiments conducted by Nario. He ligated the right and left gastro-epiploic vessels close to their union with the superior mesenteric and splenic veins, respectively. As a result there were produced within 20 minutes multiple miliary infarcts and hemorrhagic extravasations in the omentum. He also reports a case of multiple infarcts of the omentum in a woman who died of portal cirrhosis and concludes that the increased pressure within the omental veins favors the development of marantic thrombi. It is also a well recognized physiological fact that the epiploic veins become engorged with blood during the process of digestion. Animal experiments have shown that such venous congestion is most pronounced at the more dependent free margin of the omentum where the marginal veins cross. It seems then that a temporary retardation in the flow of blood through the omental venous circulation occurs during the process of digestion. An injury to the endothelial lining of the vessel during this phase, is likely to incite local clotting within the omental vein. Such a conclusion is also in harmony with the experimental findings reported by one of us (J. R.), of which mention has already been made.

Various terminologies have been applied to this disease, some of which do not characterize the pathological changes which underlie this condition. Thus, under the heading of "primary acute epiploitis," Eliason and Johnson described a series of cases which in reality are infarcts of the omentum. The term itself "acute epiploitis," as this condition has been called by them, implies that the etiological factor is localized in the omentum and is of an inflammatory nature. Specifically, the term epiploitis is therefore, a misnomer, since it signifies that the condition is inflammatory, for which there is little supportive evidence. The pathological description of their cases is typical for that of infarction produced by torsion, and not of inflammation. It is true that an inflammatory cell reaction of variable degree is commonly seen in association with the infarct in the omentum, but such a finding is not at all uncommon in infarcts that occur anywhere in the body.

SUMMARY AND CONCLUSIONS

1. Six consecutive cases of infarcts of the omentum, in which recovery has occurred following resection of the infarcted segment, are analyzed as a basis for the discussion of problems associated with this lesion.

2. The difficulty in making a diagnosis arises from the fact that the clinical picture is not pathognomonic. Similar clinical pictures may result from other acute intra-abdominal lesions, of which acute appendicitis heads the list.

3. The symptomatology, etiology, and pathogenesis of the disease are generally discussed.

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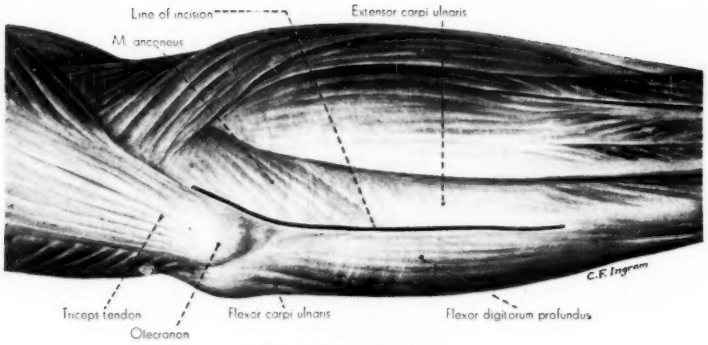

Fig. 1. Line of incision.

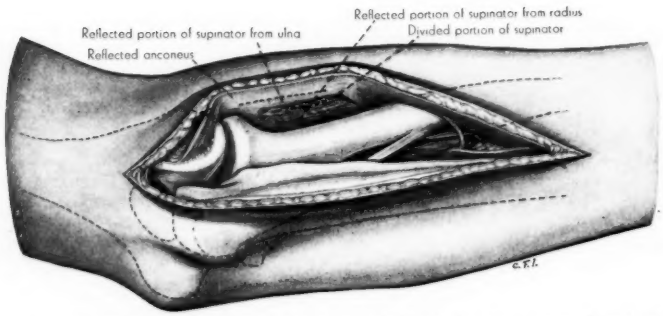

Fig. 2. Complete exposure of the upper third of the ulna, upper fourth of the radius, and radiohumeral articulation.

Surgical Exposure of Ulna and Proximal Third of Radius through One Incision.—**Harold B. Boyd.**

SURGICAL EXPOSURE OF THE ULNA AND PROXIMAL THIRD OF THE RADIUS THROUGH ONE INCISION

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EXPOSURE of the upper third of the radius without trauma to the deep branch of the radial nerve is difficult to obtain by the incisions in popular use. The approach herein described provides an excellent view of the upper third of the radius and, if required, of the entire length of the ulna, while ample protection is afforded this important motor nerve.

THE APPROACH

The incision is begun in a direction ¾ inch proximal to the tip of the olecranon on the external border of the triceps tendon and is extended downward along this structure to its insertion into the olecranon, thence is continued along the radial side of the subcutaneous triangle, which forms the dorsal surface of the olecranon, to the apex of the triangle. From this point the incision follows the dorsal border of the ulna distally, if necessary, to the styloid process. On the radial side of the incision are the anconeus and extensor carpi ulnaris muscles, while on the ulnar side are the distal portion of the triceps tendon and the flexor carpi ulnaris and flexor digitorum profundus muscles (Fig. 1).

The insertion of the anconeus and origin of the supinator muscles are elevated subperiosteally from the dorsal surface of the ulna, as are also the origins of the abductor pollicis longus, extensor carpi ulnaris, and extensor pollicis longus muscles throughout the extent of the incision. Stripping of these structures, being subperiosteal, is accomplished with ease. The deep muscle fibers of the supinator which arise from the triangular depression below the radial notch are next divided close to the ulna.

The muscular flap may now be retracted radially to expose the radiohumeral articulation, the head and neck of the radius, and that portion of the shaft above the upper margin of the interosseous membrane (Fig. 2). If further exposure of the radius is desired, the dorsal interosseous artery may be ligated at the upper margin of the membrane and the muscular flap reflected subperiosteally from the ulna down to the interosseous membrane, thence laterally along the dorsal surface of the membrane to the radius. In this manner, slightly more than the upper third of the radius may be exposed without disturbing the deep branch of the radial nerve.

From the Willis C. Campbell Clinic.

To appreciate the protection afforded the deep branch of the radial nerve by this approach, one must understand the relation of the nerve to the supinator muscle. The nerve enters the forearm through the superficial and deep planes of the supinator muscle, thus, when this structure is detached from its origin and elevated from the neck and upper portion of the shaft of the radius, the nerve is protected by the deep plane of the muscle. Figure 3 illustrates the course of the nerve through the supinator muscle. The numbers *59*, *60*, *61*, and *62* indicate the levels of the corresponding cross sections in Figure 4. From the location of the nerve and the line of the incision as demonstrated in these cross sections, it is obvious that the nerve remains safe in the substance of the reflected supinator muscle.

This approach has been used in the treatment of 9 patients, its extent being varied in each to meet individual requirements. Seven of the patients had fractures of the ulna with dislocation of the head of the radius. In these, the incision is ideal, in that it affords adequate exposure for internal fixation of the ulnar fracture, reduction of the head of the radius, and restoration of the annular ligament. While making the approach, a strip of deep fascia, 4 to 5 inches in length and ½ inch in width, may be elevated from the forearm and left attached at its junction with the perios-

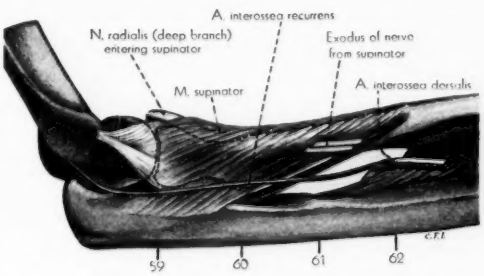

Fig. 3. Illustrating the relation of the deep branch of the radial nerve to the superficial and deep planes of the supinator muscle. The numbers *59*, *60*, *61*, and *62* indicate the levels of the cross sections shown in Figure 4.

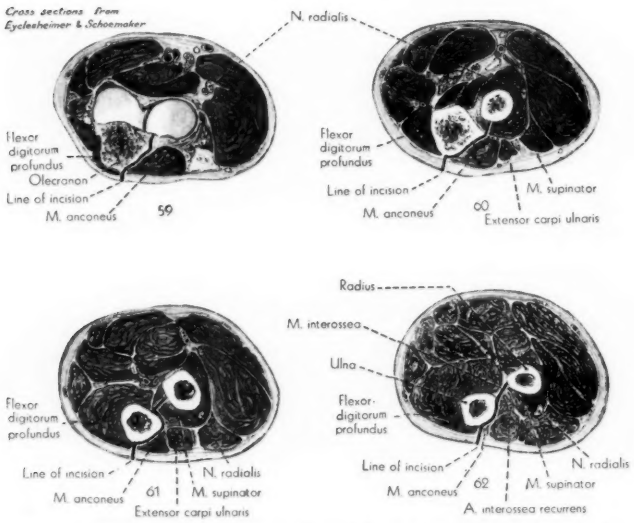

Fig. 4. Cross sections showing the relation of the deep branch of the radial nerve to the line of incision and to the supinator muscle at the levels indicated in Figure 3. (Cross sections redrawn from Eycleshymer and Schoemaker.)

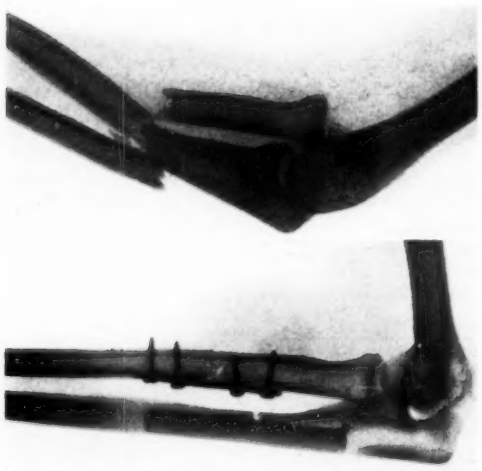

Fig. 5. Above, fracture of both bones of the forearm at the junction of the upper and middle thirds with dislocation of the head of the radius. Below, Vitallium plates have been applied to both fractures, the dislocation of the head of the radius reduced, and a strip of deep fascia from the forearm passed around the neck of the radius to replace the annular ligament. This was accomplished through one incision.

teum near the proximal end of the ulna. After reduction of the head of the radius, this strip is passed around the neck of the radius and is sutured onto itself. Thus the annular ligament is replaced.

This incision was also used in the treatment of a fracture of the ulna with an associated comminuted fracture of the head of the radius. Internal fixation was applied to the fracture of the ulna, and removal of the head of the radius was undertaken.

The ninth patient had a fracture of both bones of the forearm at the junction of the upper and middle thirds, accompanied by dislocation of the head of the radius. Vitallium plates were applied to both of the fractures to secure internal fixation and a new annular ligament was constructed, as herein described, through the one incision (Fig. 5).

At this late date in surgical history the development of a new incision is highly unlikely, yet a search of the literature has failed to reveal a description of this approach. Originality, although of academic and historical interest, has little significance for the surgeon. Of significance, however, is the fact that the incision is not generally known and its advantages, therefore, are not widely appreciated.

CONGENITAL RECTOVAGINAL DEFECTS

Operative Repair

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THE principal considerations in the operative repair of congenital rectovaginal defects are: (1) to close the fistulous opening; (2) to repair the perineal defect, if present; (3) to remedy associated developmental defects, usually those due to imperfect development of the proctodeum or of the postallantoid hindgut.

EMBRYOLOGY

In order to understand fully the anatomical situation found in the case herein described, it will be worth while to review briefly the developmental anatomy of the genitorectal apparatus. A thorough knowledge of the embryology explains the numerous other anomalies of the region in a rational way and integrates an apparently heterogeneous group of situations.

The mucosa of the intestinal canal is derived from entoderm with the exception of its oral and anal extremities. It is enveloped by a layer of mesoderm which divides into two portions, forming the peritoneum and the muscle and connective tissue of the gut wall (2).

In the 3 to 5 week embryo, the hindgut and the allantoic stalk are united caudally in a communal dilatation, the cloaca (4). (Fig. 1.) That portion of the hindgut later forming caudad to this union is called the postallantoid hindgut and descends toward the proctodeum.

The cloaca is divided at about 9 weeks into an anterior and a posterior portion by the descending urogenital membrane (urorectal septum). The anterior portion (from the allantois) becomes the urachus, urinary bladder, and genitalia. The posterior portion becomes the rectum. The proctodeum is established opposite the postallantoid rectum and becomes the anus and its external sphincter.

As the rectum proceeds caudad, the proctodeum invaginates until the attenuated intervening membrane ruptures. We see diagrammatically (Fig. 3) the situation just before this occurs (5). The rectum is well formed and is nearly ruptured through the proctodeum. From the urogenital sinus has projected the uterovaginal anlage, and the urogenital membrane has become a substantial perineum.

The following statements now become self-explanatory: (1) A persistence of the cloacal intercommunication will leave an opening between the rectum and any of the derivatives of the allantois: urethra, bladder, vulva, vagina, and uterus. (2) A defect in the caudal portion of the urogenital membrane will result in a rectoperineal fistula. (3) Incomplete or imperfect downgrowth of the postallantoid hindgut may cause the rectum to end blindly to be united to the proctodeum by a cord, or to exhibit variable degrees of stricture. (4) An imperfect development of the proctodeum may cause a persistent anal membrane, complete or incomplete. The proctodeum is rarely entirely absent. These four types of anomalies may occur singly or in any combination.

Because the existence of the proctodeum is independent of the development or even the proximity of the terminal gut, it follows that in the

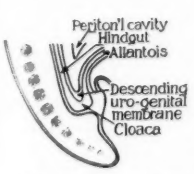

Fig. 1, left. Median section of a 9 millimeter embryo. Modified from V. C. David.

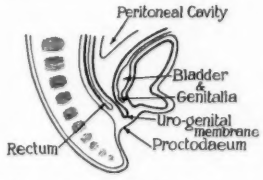

Fig. 2. Median section of a 12 millimeter embryo. Modified from V. C. David.

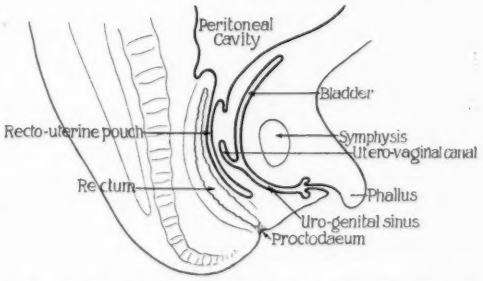

Fig. 3. Median section of a 50 millimeter embryo. Modified from Keibel and Mall.

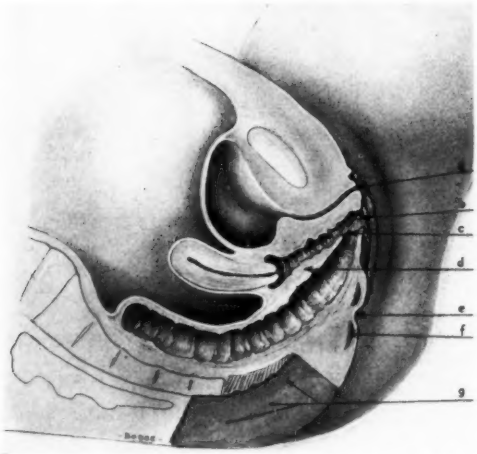

Fig. 4. Schematic drawing showing location of fistula and first stage of operation. *a*, urethra; *b*, vaginal outlet; *c*, rectal opening; *d*, rectovaginal septum; *e*, dimple; *f*, sphincter and externus; *g*, incision with removal of coccyx.

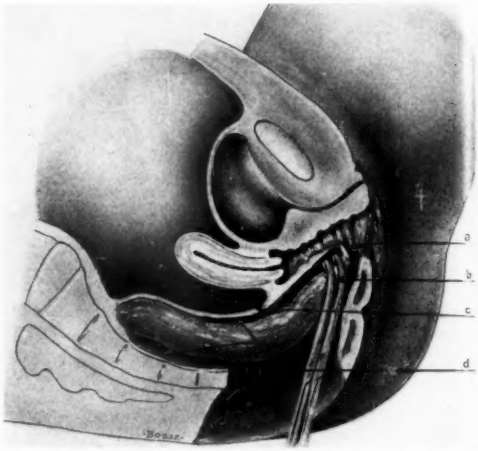

Fig. 5. Mobilization of the rectum. *a*, Rectal opening; *b*, site of division; *c*, peritoneum; *d*, space developed about the rectum by means of blunt dissection.

majority of rectal atresias the anal dimple and surrounding actively functioning sphincter are present (2). Thus, if operative repair is successful, adequate sphincter control ensues.

INCIDENCE OF ANOMALIES

A brief survey of the literature reveals wide variation in the statistics quoted by various authors. In 66,654 deliveries, three cases of imperforate anus were noted (3). Berman, writing in 1938, reports 22 anomalies in 34,454 admissions at the Riley Hospital in Indianapolis. This probably is not an accurate determinant of the proportion in the population at large. He quotes Ball, who found about one anomaly in 5,000 births. David states that the incidence is between 1: 5,000 and 1: 10,000. Webb records 1: 7,581 (Ziemendoff) and 1: 10,000 (Neff). So we see that the figures vary from Berman (about 1: 1,600) to Zoehrer and Collins (about 1: 22,000). The actual figure is somewhere between these two. Certainly, at any rate, the general surgeon will only exceptionally see a large series of cases.

Of Berman's 23 cases, only 5 were similar to the one reported. However, in imperforate anus with vaginal rectal outlet, the vast majority of openings is in the vulva. There have been relatively few examples of rectovaginal communication above the vestibule (8).

CASE REPORT

J. C., aged 1 year 8 months, of Italian parentage, was admitted to the hospital September 13, 1933. Nineteen months previously, she had been brought to the out-patient department at the age of 3 weeks because of constipation and the fact that her mother had attempted to give an enema and could find no anal opening. There was no suggestive family history. One sibling died at birth—was said to be premature.

Delivery at term was normal. Her birth weight was 6½ pounds. Her first tooth appeared at 6 months, but at 1 year she sat up for the first time and on admission had not yet walked or talked. She had had whooping cough but no other diseases of note.

In the out-patient department, it was noted for the first time that there was no anal opening and that the stools were passed through the vagina. It was decided to postpone surgery until the infant was sufficiently developed. She was therefore seen in the clinic, receiving dilatations from time to time and making satisfactory physical progress. An x-ray study of the rectum was made by injecting the contrast medium through a catheter inserted into the vaginal opening. The findings indicated a congenital atresia of the anal canal near the internal sphincter.

Examination on admission to the hospital revealed a fairly well developed and nourished infant with a dull facial expression, unable to sit or stand alone. There were present 6 upper and 6 lower teeth. No cardiac abnormalities were noted. The abdomen was distended, soft, tympanitic, but no masses were found. Feces were being discharged from the vagina with some difficulty. The anus was absent but there was a slight dimpling at the usual anal site which puckered when the child cried.

The Mantoux and Wassermann reactions were negative. The urine was not abnormal. The leucocyte count was normal. The erythrocyte count was 3,560,000, hemoglobin 60 per cent (8.7 grams per 100 c. cm.).

The diagnosis was congenital rectovaginal communication, congenital imperforate anus, and mental deficiency.

On September 15, 1933, under ether anesthesia, a repair of the fistulous communication was attempted (R. F. C.). An incision was made in the midline of the perineum from the posterior vulvar margin toward the anal dimple. This

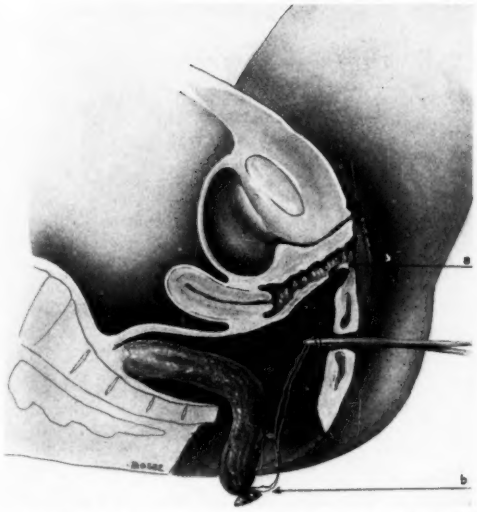

Fig. 6. Rectum tied off and ligature grasped with clamp inserted through anal incision. *a*, Rectal opening; *b*, rectal end.

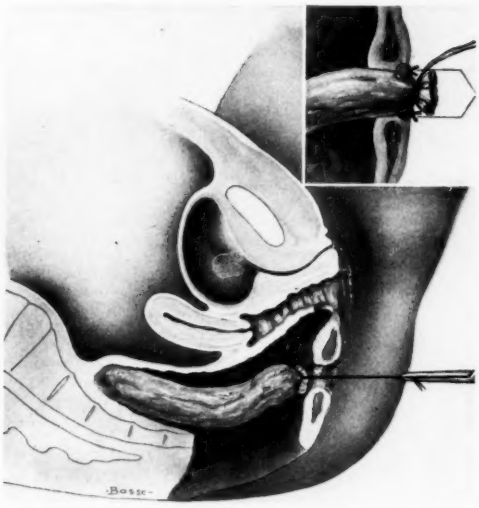

Fig. 7. Rectum being drawn through new opening. Inset shows the method used in sewing the rectum to the anal skin.

exposed the vaginal outlet and the rectal opening was found to be on the posterior inferior vaginal wall just inside the posterior commissure. A longitudinal septum was seen to divide the vaginal cavity into two lateral compartments.

The perineal incision was continued forward around the rectal opening which was then separated from the vagina. The rectum was depressed backward and its mucosa was sutured to the skin of the perineum. The levator muscles were united between the vagina and rectum and the closure was finished in the usual perineorrhaphy fashion.

Subsequent bowel movement forced the levator muscles apart, and feces were discharged through the extent of the wound. The posterior portion eventually united, leaving the situation essentially as it was at the outset.

Two years later, on October 28, 1936, she was re-admitted for observation. She had been treated in the clinic, receiving dilatations, and for the previous 8 months had had one daily stool without medication and with fair control. She was classified as a mentally deficient microcephalic and was discharged without treatment.

At the age of 6 years and 4 months (May 11, 1938) she was re-admitted because of constipation. The stools were passed through the vagina with great difficulty and the aid of mineral oil. Psychometric studies classified her as a mental defective, imbecile grade. The following day, under ethyl chloride and ether anesthesia, operation was again performed (R. F. C.). The patient was placed in the Sims' position, left side downmost. A linear midline incision was made over the terminal sacral segment and the coccyx, and carried downward to within an inch of the anal dimple (Fig. 4). The coccyx was removed in the usual fashion. The rectum was separated from the vagina anteriorly by blunt dissection. The separation was continued laterally about the rectum and with a finger inserted into the anus, down to its exit in the posterior vaginal wall. It was also freed from the anterior aspect of the sacrum and from the adjacent peritoneum of the pouch of Douglas (Fig. 5). The terminal rectum was doubly clamped and cut with a cautery. The proximal stump was tied with a ligature, left long. A stellate incision was made through the skin dimple, taking care not to injure the sphincter, and a clamp was put through the muscle, grasping the ligature on the end of the apparently normal rectum (Fig. 6). The rectum was then pulled through the stellate incision and the clamp holding the vaginal opening from behind was released and withdrawn (Fig. 7). The coccygeal incision was closed in layers with a small drain at the lower angle. The patient was then put up in lithotomy position. The rectum was sewed to anal skin (Fig. 7, inset Fig. 8) and the previously made vaginal opening enlarged longitudinally. A typical perineal repair was accomplished (Fig. 9). The skin was closed with interrupted catgut sutures (Fig. 10).

The postoperative course was uneventful. On the sixth day she became moderately distended, but feces and gas were passed adequately after a manual dilatation. On the ninth day, she was having spontaneous bowel movements and was comfortable and afebrile.

Following discharge, she showed little ability (or desire) to control movements and 3 weeks later was re-admitted for dilatation under anesthesia. This was done with the liberation of a large amount of fecal material.

Subsequently she was dilated under anesthesia four times in 6 months. There was a lapse during this interim of 2 months when no dilatations were attempted because of a severe intercurrent rheumatic carditis. Because of this, apparently, she developed an anal fecal fistula. The rectovaginal communication remained closed.

The mental deficiency contributed to the postoperative difficulty in handling the dilatation of the anus necessary in these patients. Under normal circumstances, digital dilatation of the new anus should be carried out twice weekly and without the use of an anesthetic. In this instance an anesthetic was used to avoid the strain upon the heart caused by the struggling of the patient while being held for the dilatation.

Fig. 8. Longitudinal incision through original fistulous opening. *a* and *c*, incision; *b*, rectal opening; *d*, transplanted rectum; *e*, suture of rectum to anal skin.

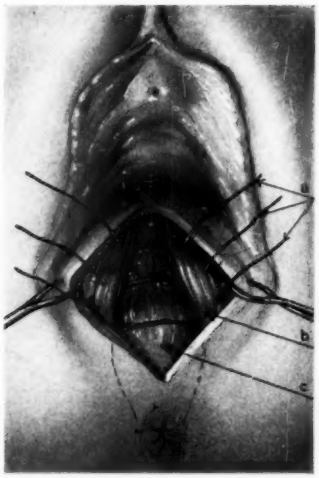

Fig. 9. Perineal repair. *a*, Sutures to approximate levators; *b*, levator ani muscle; *c*, rectum.

It is best to wait until a child is at least in its second year of life before an attempt is made to repair a congenital rectovaginal defect. Operation fails to effect a cure in 50 per cent of cases and the mortality is high in the newborn (2).

In some instances a narrow communication will close spontaneously if the rectal opening be well established; at any rate, dilatations can be safely repeated until operation is justified.

If dilatation is not adequate, colostomy can always be resorted to. "When in doubt, do a colostomy" is probably good advice when taken

Fig. 10. Appearance at end of operation.

Fig. 11. Photograph taken 30 days after operation. Patient continent for gas and feces.

judiciously (6). Colostomies are urgent for 2 reasons: (1) If a fistulous connection with the bladder or urethra exists leading to danger of ascending urinary infection, (2) if there is complete obstruction and extensive operative procedure is inadvisable. Postoperative dilatation of the rectum at regular intervals is important. If the rectum is greatly overdistended by feces, the chances of a perineal breakdown are greatly enhanced.

SUMMARY

Rectovaginal defects are rare. The embryological factors in their production are discussed and illustrated. In the case presented the rectum communicated with the vagina just above the vaginal outlet, and there were an imperforate anus and a complicating microcephalic mental deficiency. Operative repair was accomplished by transplantation of the terminal rectum to the usual anal situation. The importance of frequent postoperative anal dilatations is emphasized.

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TUBAL STERILIZATION BY THE MADLENER METHOD

A Critical Analysis of Failures

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NO method of sterilization upon the human female has stood the test of time; at least occasional isolated cases of failure have marred the previously perfect records of each. Even supravaginal hysterectomy does not offer a positive safeguard against subsequent pregnancies. Liepmann reported an abdominal pregnancy, primary tubal, occurring in a patient 2 years after supravaginal hysterectomy with excision of an intraligamentous cyst. An even more remarkable incident was reported by McMillan and Dunn, in which two pregnancies occurred in the same patient within 3 years after "supravaginal hysterectomy with excision of all of one fallopian tube and ovary and most of the other tube, leaving in only one ovary and about one and one-half inches of the fimbriated end of the corresponding fallopian tube, and stitching these remaining organs in with the peritoneum that was drawn over the stump of the cervix."

The Madlener method, which was introduced in 1919 (4), became the most popular method of sterilization on the obstetrical service of the Johns Hopkins Hospital in 1936, for several reasons: (1) it offered a relatively bloodless operation at the time of cesarean section or during the early puerperium; (2) it could be carried out in a shorter period of time and the operative time thereby reduced; (3) it seemed to be a method which could be safely performed by any surgeon, irrespective of how little his surgical experience; (4) its incidence of failures as reported in the literature in general was quite low; and (5) it offered the easiest tubal method by the vaginal approach. Our use of the method has borne out each of these contentions except that in our hands its percentage of failures has been high. One hundred and one sterilizations were performed by this method (31 in 1936, 43 in 1937, and 27 in 1938) and to date we have witnessed 5 clinical failures, as evidenced by a subsequent intra-uterine pregnancy beginning 0 (Case 2) to 20 (Case 4) months after sterilization in each of 5 patients.

Eighty-eight sterilizations were accomplished by the abdominal route and 13 by the vaginal. Forty-seven were performed in conjunction with term and 7 with premature classical cesarean sections. Fifteen were done at the time of interruption of pregnancy by abdominal hysterotomy. Twelve were performed abdominally during the first 3 weeks of the puerperium; and 20 as interval operations, the average period following the termination of a pregnancy being 37 weeks and ranging from 5 weeks to 4 years. The indications for Madlener sterilization are listed in Table I, while the salient clinical features of the cases in which the operation failed are shown in Table II. Gross and microscopic findings of the fallopian tubes in the latter cases follow:

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CASE 1. L. G. No. 135891; C. W. 5572. When the abdomen was opened in order to resterilize the patient, many adhesions were found, among these the apex of the knuckle of right fallopian tube where it had previously been sterilized by the Madlener method, to the lateral pelvic wall. The left adnexa were free of adhesions and there appeared to be a thinned area made up of little more than peritoneum at the junction of the proximal and middle one-third of the tube.

The resected portion of the right fallopian tube was made up of the knuckle and short proximal and distal portions of more normal appearing tube, but the whole piece of tissue measured only 3 centimeters in length. The whole of this block was serially sectioned.

The left tube was represented by two pieces of tissue. One was the outer one-third of the tube and presented normal ampullary portion and fimbriated end on both external surface and cross section. The median portion of this fallopian tube measured 4 centimeters in length and 1 centimeter from its inner excised end, a compressed and thinned area began but extended for a distance of only 5 millimeters. This thinned area, plus a small region of each proximal and distal extremity, was serially sectioned.

Microscopic pathology. The left fallopian tube was patent lateral to the thinned area and represented the relatively normal ampullary portion of the tube. The site of the previous sterilization contained no tubal lumen, its expected site was replaced by solid scar tissue (Fig. 1). Some strands of the black silk suture were seen in these sections but there was no evidence of any foreign body reaction.

The right fallopian tube was patent lateral to the previously ligated knuckle, although even here the lumen was smaller than normal and was lined with a low type of epithelium, which was not thrown up into complicated folds, but rather represented the type of tubal lumen seen in the interstitial portion of a tube. The knuckle of the tube was made up in large measure of scar tissue. The small tubal lumen was seen in some of this scar tissue and at the opposite side of the tube was another and solid area of scar tissue, which was thought to represent the obliterated lumen of one arm of the knuckle (Fig. 2). Medial to

Fig. 1. Case 1. The thinned area of the left fallopian tube showing no evidence of a tubal lumen, but its former site occupied by a solid area of scar tissue. ×7.

the knuckle the tubal lumen was patent and presented a picture essentially the same as that lateral to the knuckle. As the lumen was followed up along the medial side of the knuckle, eventually a point was reached where the lumen communicated with the external surface of the tube (Fig. 3), and lateral to this region for a short distance no tubal lumen was present.

In summarizing, the cause of failure in sterilization by the Madlener method in this case cannot be found in the left fallopian tube. The only explanation for the resulting pregnancy is found in the tuboperitoneal fistula on the medial side of the ligated knuckle of the opposite (right) fallopian tube. Apparently a process of endosalpingiosis occurred on the medial side of the ligated knuckle of this tube and extended outward toward the region where the knuckle was adherent to the lateral pelvic wall. Sampson has shown that this process can extend into other organs that are adherent to a traumatized fallopian tube.

The sites of sterilization in this patient were apparently the junctures between the inner and middle one-thirds of the tubes, and since Madlener (4) originally stressed the selection of a site where the tube was freely movable, at its midpoint or lateral to this, it may be assumed that failure followed the improper selection of the sites for ligature as well as the traumatization of the serosa of the right fallopian tube.

Case 2. O. McC. No. 127709; C. W. 5634. At the time of the second sterilizing operation, the left fallopian tube was said to have shown gross evidence of salpingitis, was densely adherent to the left ovary, and still assumed the knuckle-shape formed at the previous operation. The silk ligature could be identified. The right fallopian tube and ovary also evidenced signs of old salpingitis, but nowhere could the site of sterilization be seen and this tube (right) was thought responsible for the subsequent pregnancy.

The right fallopian tube was small and presented a thinned area 4 centimeters from the uterine cornu and 1.5 centimeters from the lateral end of the tube; the fimbriated end was not present. The left fallopian tube was somewhat

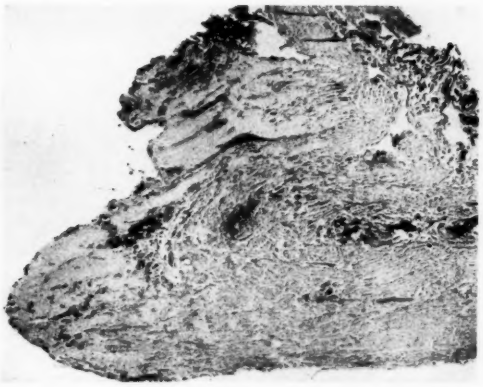

Fig. 2. Case 1. One-half of section through the ligated knuckle of the right fallopian tube, showing chiefly scar tissue, but also scattered areas of smooth muscle. This probably represents the replaced lumen of one arm of the knuckle. The other one-half of this section shows a small and abnormal tubal lumen in a large area of scar tissue. ×7.

longer than the right and was adherent by fine old adhesions to the anterior surface of the ovary. This tube was rather normal in appearance except for one nodulated area covered by adhesions and still containing the suture used to ligate this tube. This ligature was located 5.5 centimeters from the uterine cornu and 3 centimeters medial to the normal fimbriated end.

Microscopic pathology. The right fallopian tube presented a patent lumen throughout. The latter was rather characteristic of the outer isthmic portion except that the folds of epithelium were either absent or small and few in

Fig. 3. Case 1. High power magnification of a part of the section across the medial side of the knuckle of the right tube, showing the small and abnormal lumen communicating with the external surface of the tube. The subsequent pregnancy is believed to have occurred by way of this tuboperitoneal fistula. ×65.

Fig. 4. Case 2. Section across the ligated knuckle of the left tube, showing an adequately patent tubal lumen, with epithelial folds characteristic of the isthmus and the muscularis surrounded by a thick layer of scar tissue. At the opposite end of the knuckle, note the large cavity in an area of scar tissue, lined by connective tissue, and representing the degenerated arm of the ligated loop of tube. Between these two areas there is a large area occupied by lymphocytes, silk suture material, débris, and foreign body giant cells (Fig. 5). ×6.4.

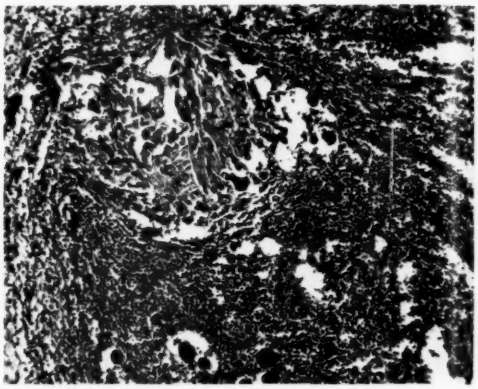

Fig. 5. Case 2. High power magnification of the necrotic area seen in Figure 4, showing lymphocytes, foreign body giant cells, and silk suture material. ×65.

number at the margin opposite the mesosalpinx. Here, also, the serosa and tubal musculature were thinner than elsewhere and thinner than normal, with the tubal lumen approaching more nearly the serosal surface. There was no evidence of the ligature or of foreign body reaction in any section.

The left fallopian tube, again, was patent throughout, but somewhat larger than the right, with tubal epithelial folds more characteristic of the ampullary region. In the region of the knuckle there was a cavity opposite the lumen, which corresponded in size and shape to the tubal lumen, but was lined with connective tissue that was thrown up into small folds and seemed to represent a degenerated arm of the crushed and ligated loop (Fig. 4).

There is no doubt that the right fallopian tube was traumatized at the time of Madlener sterilization, but the presence of a complete lumen with absence of the non-absorbable suture and foreign body reaction, leads one to suspect that the suture either slipped off or cut through the ligated knuckle. Again, since the left tube was traumatized and ligated, one arm degenerating partially while the other was preserved rather than possibly regenerated, some flaw in crushing or tying the knuckle of this tube is suggested. While pregnancy in this case certainly could have occurred by way of either fallopian tube, the left was most likely the offender, for here we observed a larger and more normal lumen and the corpus luteum of pregnancy was located in the left ovary. On the other hand, careful mensuration of the fetus left little room for doubt that the pregnancy existed at the time of sterilization and in all probability the fertilized ovum had passed the region of ligature, very probably already implanting in the uterine cavity. Thorough curettage should have recovered the fertilized ovum and most certainly microscopic examination of the curetted endometrium would have aroused the suspicion of an existing pregnancy.

Case 3. O. M. No. 110293. C. W. 5698. At laparotomy for the second sterilizing operation, each tube was remarkable only on account of the presence, near its mid-point, of a loop of black silk which was so located as to give the impression of having been placed in the tubal musculature and serosa directly opposite the mesosalpinx. That portion of each tube marked by the silk suture was removed before the sterilization operation was continued by the Irving method.

Each block of fallopian tube measured roughly 1 centimeter in length and normal appearing tube lay beneath a knot of black silk suture material in the serosa opposite the mesosalpinx. The whole of each was serially sectioned, after the suture material had first been removed.

Microscopic pathology. The right fallopian tube was patent throughout, but the lumen was smaller than normal. The lining epithelium varied from low cuboidal to typical columnar. In some regions it was thrown up into simple folds, whereas in others there were ill-defined folds. Moreover, nowhere did it give the characteristic appearance of the ampullary portion of tube, but rather that of the interstitial or isthmic portions. In all sections the muscular coat was thickened and scarred and one did not observe the typical inner circular and outer longitudinal layers of smooth muscle. Lateral to the musculature and particularly in the direction away from the mesosalpinx, there was considerable scarring. The only evidence of foreign body reaction was in the occasional small nest of lymphoid cells.

The left fallopian tube was very much like the right, but the lumen was generally slightly larger and the lining epithelium was thrown up into more numerous but simple folds. In one region there were several secondary lumina besides the usual lumen, but all lined with similar epithelium (Fig. 6). Inspection of the serial slides in this

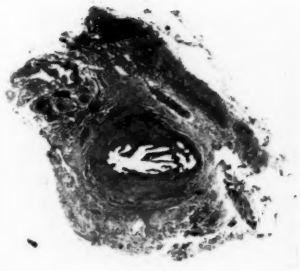

Fig. 6

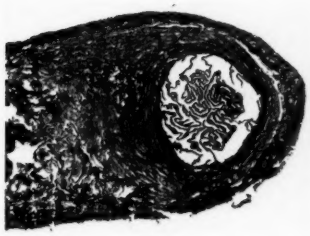

Fig. 7

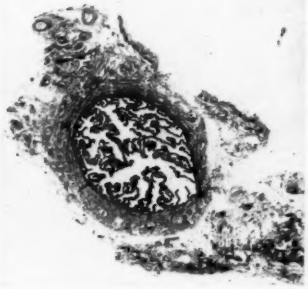

Fig. 8

Fig. 6. Case 3. Cross section of the left tube. In this photomicrograph are shown, besides the usual lumen, several secondary lumina, i.e., pockets or pouches of the true lumen. ×8.

Fig. 7. Case 4. Section across the left fallopian tube, showing a lumen resembling the normal isthmic portion of a tube, but approximating a large area of scar tissue. The opposite end of tissue contained no tubal lumen, was made up of scar tissue, and probably represented a degenerated arm of the ligated knuckle. ×7.

Fig. 8. Case 5. Section across the distal end of the ligated knuckle of right tube, showing a relatively normal cross section of ampullary portion of tube. The opposite end of tissue is made up of solid scar tissue and represents the terminal end of the opposite and degenerated arm of the ligated knuckle of the tube. ×8.

region showed that these secondary lumina represented pockets or pouches in the true tubal lumen.

The whole picture of these fallopian tubes was not suggestive of sloughing off of the ligated knuckles with fusion of the liberated ends, but rather one of partial or complete destruction of the original tubal lumina, with a regeneration and recanalization of each. It seems highly probable that in this case the knuckles of fallopian tube were inadequately ligated, too loosely, perhaps, with the ligatures slipping off and the traumatized tubal epithelium regenerating.

Case 4. A. P. No. 152744; C. W. 5715. On inspection of the fallopian tubes at the time of laparotomy to resterilize the patient, it appeared that the right tube was satisfactorily occluded. The two bisected ends of this tube could be seen through the peritoneum and appeared to be several millimeters apart, with their ends well sealed. There was a labyrinth of veins just beneath this area, so it was not resected but Irving sterilization was carried out proximal to the site of the previous sterilization. The left fallopian tube appeared normal except for a speck of black silk suture material which could be seen through the peritoneum. This strip was resected and the distal end of the proximal portion, like that on the opposite side, was buried in the musculature of the anterior uterine wall.

The specimen of fallopian tube measured 2 centimeters in length and contained a small piece of black suture material in the peritoneum opposite the mesosalpinx. The suture material was removed and the specimen was placed in a single block for serial section.

Microscopic pathology. The left fallopian tube was patent throughout. The lumen was generally rather large and the epithelium and its folds characteristic of the isthmic and ampullary portions of a normal fallopian tube. Many of the epithelial folds were, however, large, contained scar tissue, and were infiltrated with some leucocytes and lymphocytes. These folds appeared to arise from the side adjoining the mesosalpinx, while at the opposite side there were very few epithelial folds and these were quite simple, many of them being short and represented only as epithelial buds (Fig. 7). In the area showing the greatest effect from trauma, there were several pockets in the tubal lumen and one of these pouches was incompletely lined with epithelium. Medial to this point, the lumen again became unilocular, but more like the inner isthmic portion of a fallopian tube.

Madlener sterilization was apparently effective on one side, the right. However, in all probability crushing and tying of the left fallopian tube was inadequate, producing partial destruction of the tubal epithelium in the ligated knuckle, followed by regeneration of the tubal lumen.

Case 5. A. P. No. 113149. C. W. 5738. At the time of the second sterilizing operation, both fallopian tubes appeared to have re-established their lumina, but the sites of previous Madlener sterilization could be identified by remaining portions of the black silk suture.

The resected portion of the right fallopian tube presented what appeared to be a loop with a piece of black silk suture around one arm of the loop; the suture appeared to have cut through the other arm of the loop, leaving a thin and fibrotic portion of fallopian tube.

The resected portion of the left fallopian tube was analyzed with difficulty, since the whole specimen was less than 1 centimeter in length. However, it also contained black silk suture material, which was apparently around both arms of a loop of tube.

Microscopic pathology. The serial sections of the right fallopian tube revealed varying pictures with rapid transitions. On the medial side of the loop there was an area of scar tissue and smooth muscle, which contained a canal lined with low cuboidal epithelium. This layer was not complete and there was no evidence of epithelial folds. Immediately adjoining the ligated loop on its medial side, the tubal lumen disappeared and was completely replaced by scar tissue, thus successfully interrupting the tubal lumen. In the region of the ligated knuckle there were two separate and distinct areas of scar tissue, each containing

TABLE I.—INDICATIONS FOR STERILIZATION BY THE MADLENER METHOD

		Cases
Hypertensive vascular disease and chronic nephritis		29
Repeated cesarean sections		22
Rheumatic heart disease		16
Psychiatric indications—		
Feeblemindedness	5	
Imbecility	1	
Idiocy	1	7
Multiparity with vaginal relaxation		6
Repeated toxemias of pregnancy		5
Grand multiparity		4
Pulmonary tuberculosis		2
Bronchial asthma		1
Previous pneumonectomy		1
Cerebral arteriovenous aneurism		1
Previous extensive vaginal repair		1
Old poliomyelitis		1
Rectovaginal fistula		1
Congenital heart disease		1
Sickle cell anemia (severe)		1
Carcinoma of cervix		1
Extensive stricture of rectum		1
Total		101

evidence of a small and abnormal tubal lumen, one with pocket-like outgrowths. Toward the distal end of the loop of tube, this arm showed increasingly more normal tubal lumen and epithelium until it joined the normal outer isthmic portion of the fallopian tube (Fig. 8). The opposite arm of the loop remained in a state of partial degeneration.

The left fallopian tube was represented in serial section chiefly as scar tissue and it was much smaller in cross section than is a normal fallopian tube. There was very little evidence of smooth muscle tissue. In each section there was a small but abnormal tubal lumen lined with epithelium. In some it was quite small and presented very rudimentary epithelial folds. In one region there were several pockets in the lumen, each of which was at least partially lined with a tubal type of epithelium. In other regions the lumen was larger but the epithelium folds no taller.

It seems most likely that the crushing and ligation of the right fallopian tube was adequate with complete scar tissue replacement of the tubal lumen on the medial side of the knuckle. Even though the lumen of the left tube was patent throughout, it was so small in certain regions that descent of an ovum through it would seem unlikely. Yet the pregnancy must have occurred by way of it. The fact that pregnancy did not recur until 13 months after the Madlener sterilization might indicate that after inadequate crushing and tying of this loop, that period of time was necessary for recanalization and regeneration of the tubal lumen.

The only other known failure of sterilization performed by other methods in the history of the obstetrical department is that of Case 6. Failure in this instance was obviously due to an oversight on the part of the operator, for at the time of the second sterilizing operation there was no evidence that excision of the right cornu had been previously attempted. Moreover, the attachment of the round ligament to the uterus on this side was intact, thus eliminating the possibility of mistaken identity, with sterilization attempted on the round ligament instead of the fallopian tube. The period of sterility following the Madlener operations which failed ranged from 5½ to 20 months.

Just how frequently failure of Madlener sterilization is due to the formation of tuboperitoneal fistulas, to re-establishment of the originally occluded lumina by endosalpingiosis, to the development of a new lumen outside the ligated knuckle, or to failure to interrupt the tubal lumina properly, cannot be ascertained from the literature. Microscopic descriptions of such fallopian tubes from the human are scarce. The 2 cases reported by Adair failed on account of the formation of a fistula in one tube of each. The cause of failure in both cases reported by Rubowits and Kobak was endosalpingiosis; in one instance the ligature had cut through an arm of the loop of fallopian tube, while in the other the new tubal lumen was shunted beneath the ligated knuckle through the mesosalpinx. Neubauer, Koehler, and Vignes, each of whom has described the microscopic appearance of a fallopian tube in which Madlener sterilization failed, attributed the occurrence of a subsequent intra-uterine pregnancy to recanalization of the lumen. Since Sampson has shown that endosalpingiosis occurs even in fallopian tubes not traumatized by operative procedures, we assume that it must be a relatively common condition following Madlener sterilization and wonder how long after the sterilization it is possible for endosalpingiosis to proceed and thus endanger the security of the operative procedure. Neubauer believed that a tubal pregnancy occurring 6½ years after a Madlener sterilization operation was possibly due to recanalization of the tube. The number of failures from Madlener sterilization should be reduced by more careful adherence to the technique as originally laid down by Madlener (4).

The development of tuboperitoneal fistulas should be avoided by the proper selection and use of the crushing instrument. Madlener (4, 5) has stoutly contended that a dull clamp with a broad crushing area, 9 millimeters, is the only safe instrument to employ. Further to avoid breaking through the serosa while crushing the loop to paper thinness, the clamp must be applied squarely. Madlener (4) suggests the inclusion of a bit of mesosalpinx and the selection of a loop of

TABLE II.—BRIEF ANALYSIS OF CASES

Case No.	Age Race Parity	Indications for sterilization: type and time of main operative procedure	Type of sterilization; postoperative course; resulting sterile period	Second operative procedure	Gross pathology of fallopian tubes	Microscopic pathology of fallopian tubes	Cause of failure of Madlener sterilization
1 L. G.	34 Black Multipara	Hypertensive vascular disease: abdominal hysterotomy. 14 weeks gestation	Madlener, bilateral. Uneventful, discharged 13th day; 14 months	Tubal resection with Irving sterilization. Classical cesarean section, term	Right—knuckle adherent to lateral pelvic wall; left—thinned area	Both tubes occluded but tuboperitoneal fistula on medial side of one	Small tuboperitoneal fistula following endosalpingiosis, right tube
2 O.McC.	32 White Multipara	Multiparity; posterior colpotomy. 4 mos. after term spontaneous delivery	Madlener, bilateral. Uneventful, discharged 5th day; None	Hysterectomy, salpingectomy, oophorectomy, 16¾ wks. gestation	Right—thinned area. Left—ligated knuckle adherent to ovary	Both tubal lumina adequately patent throughout, corpus luteum in left ovary	Pre-existing gestation, but little evidence of trauma to either ligated area
3 O. M.	18 Black Secundipara	Rheumatic valvulitis; classical cesarean, term	Madlener, bilateral. Febrile 5 days, discharged 15th day; 5½ months	Tubal resection with Irving sterilization; low cervical cesarean section, term	Black silk in serosa opposite mesosalpinx in each normal appearing tube	Both tubal lumina adequately patent throughout	Sutures slipped off and traumatized fallopian tubes regenerated
4 A. P.	29 Black Multipara	Rheumatic valvulitis; classical cesarean section, term	Madlener, bilateral. Uneventful, discharged 16th day; 20 months	Tubal resection with Irving sterilization; hysterotomy, 22 weeks.	Right—not resected Left—black silk in serosa opposite mesosalpinx	Left tubal lumen adequately patent throughout	Suture slipped off left tube, allowing regeneration of the traumatized tubal epithelium
5 A. P.	24 White Primigravida	Rheumatic valvulitis with hypertension; classical cesarean section at 35 weeks gestation	Madlener, bilateral. Eclampsia, pyelitis; discharged 28th day; 13 months	Tubal resection with Irving sterilization; hysterotomy, 11 weeks.	Black silk suture around one or both arms of ligated loops of tubes	Right lumen occluded but small lumen patent throughout left tube	Occlusion of both tubal lumina but recanalization of one by endosalpingiosis
6 L. J.	21 White Multipara	Feeblemindedness; classical cesarean section, term	Cornual excision, (?) bilateral. Uneventful, discharged 19th day; 21 months	Salpingo-oophorectomy, unilateral with term, radical cesarean section.	Left—cornual region absent Right—normal and passed saline from fimbria to uterine cavity	Right tube normal throughout; left cornua closed	Failure to excise the cornual portion of the right fallopian tube

tube which is freely movable, such as at its midpoint or even lateral to this region. The nonabsorbable suture must be placed in the crushed area and be drawn tightly in order to avoid recanalization of the lumen at a later date, or the ligature's slipping off the loop immediately or at an early postoperative period. If ligated too vigorously or at an acute angle, the loop of tube may be cut through and again a fistula may result. Many modifications have been made in this original technique and failures have occurred with the modifications. Several operators have attempted to insure obliteration of the lumen in the loop of fallopian tube by doubly ligating it with a nonabsorbable suture. This was done in 39 of our own 101 cases, and there was not a single failure in this group. Others have transfixed the ligating suture but this modification was not used in any of our cases.

No deaths followed tubal sterilization by the Madlener method in 101 patients. However, 7 deaths occurred in the total series of 470 sterilizations performed during the years which include the 101 Madlener sterilizations, making a total mortality incidence of 1.49 per cent, or 1.9 per cent of the 369 sterilized by methods other than the Madlener. One patient, in whom a pre-operative diagnosis of chronic nephritis had been made, died on the operating table at the close of the operative procedure: death was attributed to shock in this patient who was far from an ideal operative risk. The other deaths occurred on the sixth (3 cases), seventh (2 cases), and ninth (1 case) postoperative days. The cause of death in these last 6 cases was attributed to peritonitis (3 cases), paralytic ileus (2 cases), and tuberculous pneumonia (1 case).

SUMMARY AND CONCLUSIONS

1. Five clinical failures of tubal sterilization by the Madlener method were encountered in a series of 101 patients, an incidence of 4.95 per cent.

2. The areas of attempted sterilization were recovered at the time of a second sterilizing operation, from both tubes of 4 of these patients, and from 1 tube of the other. Each area was serially sectioned to ascertain the reason for failure.

3. One patient had a very early pregnancy at the time of the Madlener sterilization. In 2 instances considerable regeneration of the tubal lumen occurred, so that the ligating suture must have been improperly tied or placed or slipped off the knuckle. This error was bilateral in 1 case. In a fourth patient the tubal lumina were appar-

ently completely obliterated but eventually an inferior lumen was re-established on one side by endosalpingiosis. In the fifth instance, both tubal lumina were replaced by scar tissue but a small tuboperitoneal fistula apparently developed as a result of endosalpingiosis on the medial side of the ligated knuckle of one tube.

4. The number of failures of tubal sterilization by this method should be reduced by more careful adherence to the technique as originally laid down by Madlener, although certain modifications do not seem to have increased the incidence of failures.

5. There were no maternal deaths associated with the 101 Madlener sterilization operations but in 369 women sterilized by other methods during the same years, 7 deaths occurred.

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CONGENITAL BILATERAL ABSENCE OF THE KIDNEYS

A Critical Review with the Report of One Additional Case

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CONGENITAL bilateral absence of the kidneys has been recorded 135 times since 1663. Proved bilateral agenesia, i. e., true non-formation rather than secondary atrophy, is even less frequent, for only recently has microscopic examination been done to ascertain the presence or absence of atrophied remnants of the metanephros. Even in the late reviews (1, 23) no stress was placed on the need for a careful search of the body cavities for misplaced atrophic renal tissue.

In the case reported here, special attention was paid to the distinction, poorly made in the past, between true agenesia and mere gross absence. Microscopic examination of closely spaced sections of the body wall, from diaphragm to membranous urethra, for remnants of metanephros (and mesonephros) supplemented the usual careful gross examination.

CASE REPORT

The mother, a white multipara 40 years of age, had a normal pregnancy, except for the discharge of blood-stained fluid 7 weeks after her last menstrual period. Her previous pregnancy resulted in a normal child at full term though there had been a premature rupture of the membranes. The family history was not relevant. Physical examination showed nothing pathological. Four months before the estimated date of confinement, the patient had some bloody discharge and uterine cramps. She was given supportive treatment but, in spite of this, a complete spontaneous miscarriage occurred.

Postmortem examination by Dr. J. F. Rinehart showed a well formed white male fetus, 22.5 centimeters long from crown to coccyx, weighing 780 grams. The heart and great vessels appeared to be normally formed. The lungs were of the usual contour and lobed division. The thymus was normal. The abdominal viscera were in their usual positions. The liver was normal, the gastro-intestinal tract was normally formed and rotation of the colon was complete. The anus was perforate. No kidneys or ureters could be found, and the bladder likewise apparently was absent. Further dissection was deferred pending fixation of the tissue. The external genitalia were normally formed. The testes were still within the abdomen. Routine microscopic examination of the organs showed nothing of note. Diagnosis: male fetus, approximately 4½ months' gestation, showing congenital absence of the kidneys, ureters, and bladder.

Subsequent examination of the abdomen and pelvis by the author verified the gross normality of the abdominal structures (Fig. 1); careful additional search failed to uncover the kidneys and ureters (Fig. 2). The rena arteries were absent and no openings for them could be found in the lumen of the aorta. The adrenal bodies were absent also. The bladder, however, contrary to the findings of the preliminary examination, was present as a long narrow viscus with rugous lining extending into a normal obliterated urachus. The urethra was patent. The prostate appeared to be normal. Both hypogastric arteries were present.

Sections taken of all masses of adventitious tissue lying in the abdominal cavity proved them to be composed of lymphoid and areolar tissue. Sections then were made transversely every 3 millimeters down the posterolateral body wall and into the pelvis. The most cephalad of these, taken at the level of the first lumbar vertebra, showed no adrenal cortical tissue on either side (Fig. 3). Lying about the renal fossæ, however, were several large rounded structures made up of cells which looked like sympathetic ganglion elements. These were scattered about, as occurs phylogenetically when cortex and medulla normally fail to unite and represent the sympathetic (chromaffin) anlagen of the medullary component of the suprarenals (Fig. 4).

There was a small area on the left (Fig. 5), between the psoas and the quadratus lumborum muscles, consisting of several large epithelial cell-lined ducts, about which were grouped four or five rounded cell aggregates, with some evidence of association with small blood vessels. This structure was localized, for all sections taken lower down showed neither branching ducts and glomerulus-like masses, nor large duct formations. Grossly, no ureters could be found, and careful microscopic search proved their absence. Examination of the bladder showed no ureteral buds. The prostate was well formed and the urethra was complete, but the trigone (interureteral ridge and Bell's muscles) was absent. The testes, situated abdominally, were composed of the normal elements, with easily recognized epididymis, vas, and gubernaculum in each.

The sections aroused much speculation among those who saw them as to exactly what tissue was represented by the ductile remnants found between the psoas and quadratus muscles on the left. Their more cephalad position, their localization, and the complete lack of any parts of the ureters or ureteric buds weighed heavily in favor of their being mesonephric in origin (Fig. 5). Opposed to this idea is the fact that normally the mesonephric structures atrophy and disappear at about 7 weeks. In this fetus with metanephric absence, it may reasonably be inferred that mesonephric development was abnormal as well. In view of the fact that no ureteral elements could be found and no parts of a trigone, we may accept this as a case of renal agenesia caused by a lack of one of the essential elements of normal metanephric development, the ureteral bud.

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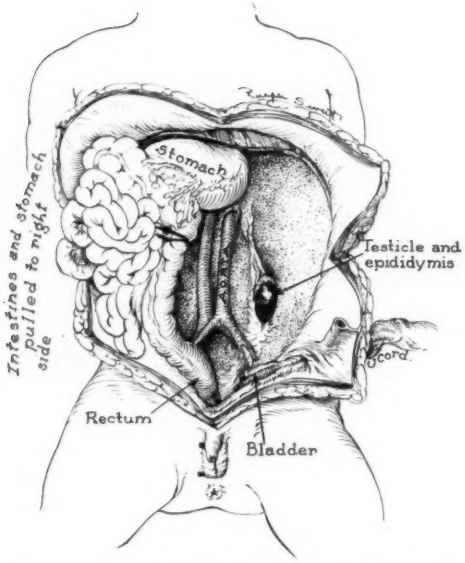

Fig. 1. Full view before evisceration, showing gross normality of lower limbs and genitalia. The aorta can be seen running on top of the psoas muscle, next to which can be seen the left testis, epididymis and gubernaculum, on the mesotestis.

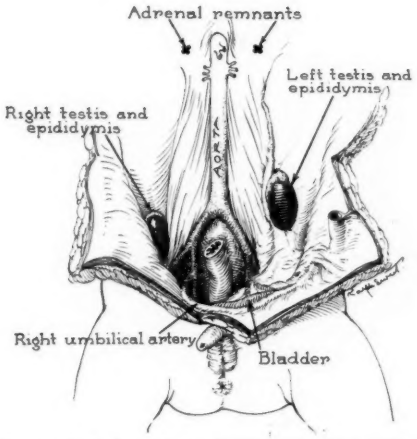

Fig. 2. Full view after evisceration with more detail. The testis, epididymis, and large gubernaculum can be seen. The phrenic branches from the aorta are too prominent. The rectum protrudes from beneath the right umbilical artery. The right testis and epididymis are just visible. Sites of adrenal remnants indicated by crosses.

REVIEW OF THE LITERATURE

In 1931, Rosenbaum combined the 32 cases previously reported by Coen with 59 additional ones from the literature, and added one new case of his own, bringing the total to 92. Madisson found 6 cases noted in the literature between 1931 and 1934, and added 4. In 1937, Amolsch rechecked the literature and noted 12 cases not included in the tabulations of Coen, Rosenbaum, or Madisson. He added 4 new cases. Amolsch omitted 1 case from Madisson's total to avoid duplication and also left out one of Rosenbaum's cases (patient number 29, who lived 14 years), leaving the total at 116. A further search of the literature added 1 case reported by Kammerhuber, 1931; 1 by Bates, 1933; 1 by Vetter, 1936; 2 cases by Giordano, 1936; 1 case by Pellicano and Raso, 1937; 1 by Raso, 1937; and 2 cases by Soloway, 1939; as well as the 9 cases cited by Raso without details (Haslinger, Rubstinat, Blackbock, Edwards, Tsuchiyae-Kobayashi, Entz, Cooper, Gilbert, and Henkel). These, with the author's case, bring the total to 135.

Though no one feature is common to all of these cases, certain generalizations can be made from them. Renal agenesia is usually associated with gross malformation of other organs. So seldom does the condition occur alone that Birnbaum was led to say that, "complete absence of both kidneys, or the presence of an undeveloped rudiment, is very rare and occurs only in monsters incapable of living." These malformations focus about the lower extremities, for out of the total 119 reviewed on this point, there were 30 recorded examples of sirenomelus, 2 of apus, and 8 of monopus, as well as 32 instances of fetuses with less spectacular malformations of the lower limbs (1). In addition, there were 9 headless monsters, all with abnormal lower extremities.

The adrenals, unexpectedly, were usually present and normal except for a change in their shape which was due to their new anatomical relationships.

The gonads were commonly present but abnormally formed. Most often the derivatives of the wolffian duct (in the male) and the muellerian duct (in the female) were affected. The bladder was absent in about half the cases. The external genitalia were usually rudimentary. In 10 cases, however, (those of Amolsch, Bates, Gowar, Huerzler, Peschke, Madisson, Mayer, Mueller, Rosenbaum, and Surig cited by Rainer) only mesonephric and metanephric abnormalities were noted. The present case brings this group to 11, or about 8 per cent. These more normal instances are strong evidence that pressure is not the sole etiological factor.

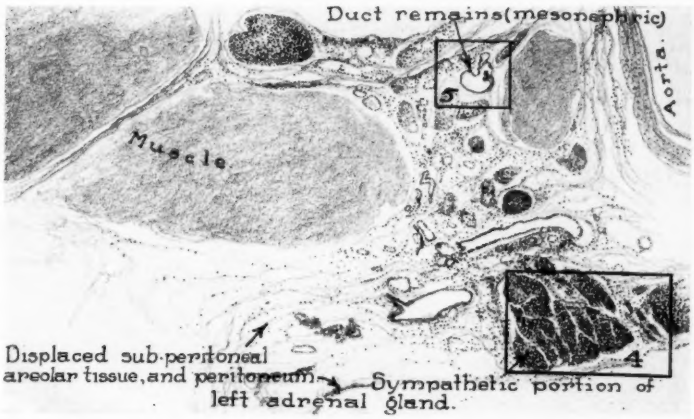

Fig. 3. Diagrammatic drawing of histological section of the left lateral body wall showing areas from which photomicrographs (Figs. 4 and 5) were taken.

ETIOLOGY

Previous papers are almost unanimous in ascribing the absence of both kidneys to pressure exerted during embryonic development. While it is true that oligohydramnios, inflammation, and amniotic adhesions are often found associated with renal absence, it is scarcely logical to insist that a decreased amount of amniotic fluid *causes* the renal abnormality; the reverse could as well be true. Renal aplasia has occurred many times without abnormalities in the amniotic fluid. In the 11 cases here cited, mesonephric and metanephric defects were the only lesions. Certainly it is far-fetched to maintain that pressure, especially by so gross a means, could cause complete aplasia of the kidneys without producing equally severe abnormalities in other organs from nearby anlagen. This argument is sharpened by the evidence in the present case, in which the testes and bladder (except for the trigone and ureteral orifices) were normal. The cortical components of the adrenal glands arise from the same mesodermal ridge as the glomerular portion of the kidneys, yet these glands are rarely malformed (note that cortical malformation has occurred in the present case).

Another hypothesis, with better evidence to support it, has been considered for many years, and recently has been strongly advocated by Madisson. He had 2 cases of bilateral renal

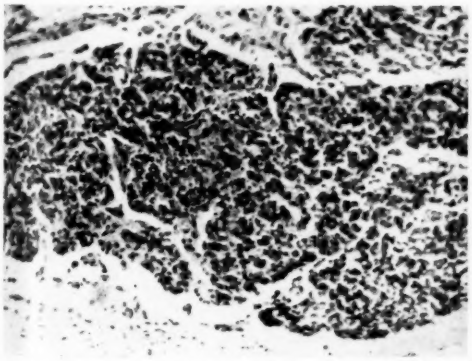

Fig. 4. Photomicrograph of a portion of several fields of developing nerve (ganglionic) tissue, some of which may have been intended for adrenal medulla.

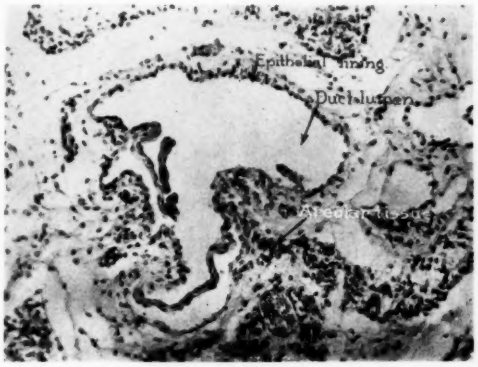

Fig. 5. Photomicrograph of a duct-like structure which is very strongly suggestive of a mesonephric remnant.

agenesia occurring in non-twinned fetuses born of the same mother. Madisson himself pointed out that, if such a lethal factor were hereditary, it would soon eliminate itself. It is not, then, a strictly hereditary characteristic but a mutation, and therefore limited to one generation. Mutation can most readily explain Madisson's cases. It cannot, however, reasonably explain the 133 other cases.

The most universally applicable explanation of anomalies of all kinds is that of developmental lag. Arey stated that, apart from those abnormalities which are admittedly hereditary and transmitted through the germ plasm in accordance with the laws of genetics, the primary cause of all abnormal development is a single factor, namely developmental inhibition or arrest. Experimenting with the marine minnow *Fundulus*, Stockard found that, by lowering the temperature or decreasing the oxygen supply—procedures which reduce oxidation and thereby slow the rate of development—he could produce any anomaly, depending on the exact moment in development at which he caused arrest. A particular type of treatment could cause all the anomalies and many different modes of treatment caused the same abnormality. The key factor seemed to be the time and degree of arrest rather than the means by which it was accomplished. The developmental rates of the whole embryo and of its various parts are not the same; periods of active growth are followed by intervals of relative nondifferentiation. Arrest during natural retardation, therefore, is innocuous, while that which occurs during the critical moments of rapid proliferation in the particular area which produces any given organ causes it to lose its temporary ascendency. If this vital moment has been lost, the undeveloped anlage must then submit to a similar dominance by the neighboring organs, it is consequently suppressed, and so fails to mature.

Riddle, agreeing in full with the conclusions of Stockard, added the idea that accelerations of metabolism (if occurring at the critical stages) are as effective as arrests, and that these favorable moments for acceleration may coincide with the indifferent periods for retardation.

We may now postulate that: (1) There is a defect (either hereditary or mutational) in the germ plasm affecting the ureterogenic area, the metanephrogenic tissue, or both anlage (Madisson, Rainer); (2) there exists a blighting factor (Amolsch), either mechanical or acting by developmental arrest, which is effective at various stages and in various areas.

From our knowledge of embryology we can be certain that the final effect will be that either (a) the ureteral bud will fail to develop, (b) the ureteral bud will appear but will fail to reach nephrogenic tissue, (c) the metanephrogenic cap will fail to develop, or, (d) the primitive metanephros later will atrophy and disappear.

The arenal siblings of Madisson illustrate the hereditary factor postulate 1, as do some instances of holoacardius and teratomatous tumors. For the blighting factor positive evidence is meager. The difficulty of accepting pressure alone as the cause was noted previously, as well as the salient arguments for the hypothesis of developmental arrest. The latter, well supported by experiment on other organ-systems, remains the one rational and comprehensive explanation for most of the recorded cases of bilateral renal agenesia.

FUNCTIONS

The necessity of functioning excretory organs in the fetus has long been open to question. Certainly the metanephros functions in fetal life as evidenced by the numerous recorded instances of mechanical block of the ureters with resultant hydronephrosis. The pronephros is, of course, vestigial in man. Mesonephric excretion is open to question. Felix, 1912, following the line of reasoning of Weber, insisted that the mesonephros does not function, since it degenerates at 7 weeks, at which time the metanephros has just reached the anlage of the second generation of the uriniferous tubules. If, then, the mesonephros functioned as an excretory organ, this function would be interrupted by its degeneration, leaving a period during which there was no excretion; this, in turn, would be reflected in the faulty development of the fetus. Felix' conclusion was, "Consequently, I regard the question as to the function of the mesonephros as settled; it does not function as an excretory organ." On examination of the cases of bilateral renal agenesia, however, we find that the fetus may live to term, even for 11 days after birth (18). Hence the fact that the embryo would go through a period without excretory organs, after the degeneration of the mesonephros and before the development of a metanephros, hardly proves that the mesonephros never functioned as an excretory organ but merely indicates that its function is superfluous. Examination of its structure makes it reasonable to assume that it forms an excretion.

The fact that an anephric fetus can come to term proves that neither mesonephric nor metanephric function is necessary for development.

It is interesting to note that 11 days, the longest period that a baby with absence of both kidneys has lived, is approximately the interval that an adult is able to survive after bilateral nephrectomy.

SUMMARY

1. One new case of bilateral absence of the kidneys is reported.

2. A review of the literature yielded 134 previous cases of renal agenesia, the majority associated with gross malformation of other organs.

3. In this case the ureters, interureteral ridge, and vesical trigone also were absent and none of the cortical component of adrenal glands could be found although sympathetic ganglion elements were present. There was no other gross malformation.

4. The traditional etiological explanations are reviewed, with criticism of the hypothesis of pressure and emphasis on that of developmental arrest. The rare possibility of an inherent defect in the germ plasm is admitted.

5. Note is made that metanephric excretion occurs during fetal life, but is not vital to normal fetal development.

Grateful acknowledgment is made to Dr. C. L. Connor, professor of pathology, and Dr. J. F. Rinehart, associate professor of pathology, for permission to report this case and for their encouragement, help, and generous loan of the facilities which permitted it.

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INVERSION OF THE UTERUS

A Report of Five Personal Cases

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INVERSION of the uterus is considered a rare lesion which may have a gynecologic or an obstetric origin. Pedunculated myomas or sarcomas are ordinarily responsible for the gynecologic inversions. The obstetric or puerperal inversions, which are the most common, are complications of the third stage of labor and form the basis of discussion in this paper. They may be incomplete when the uterine fundus does not extend farther than the cervix, and complete if any part of the corpus passes through the cervical ring. In extreme cases inversion of the vagina accompanies that of the uterus. Again, inversion of the uterus may be classified as acute, when the condition is seen early and the uterus can be replaced manually; subacute, when the cervical ring has formed and reposition from below is impossible; and chronic, when the lesion has existed for more than a month and involution of the uterus has taken place.

The incidence of inversion of the uterus varies in different clinics. Bland and Goldstein give an idea of it by the following figures taken from their article in Davis' *Gynecology and Obstetrics* (1): Zangemeister, 1 in 400,000; Von Braun, 1 in 250,000; Madden, 1 in 190,800; Cache, 1 in 4,600; Aveling, 1 in 100,000; Hirst, 1 in 140,000; Beckman, 0 in 250,000; Winckel, 0 in 20,000; Nacke, 1 in 10,000; Krassowsky, 1 in 200,000; and Leningrad, Lying-In Hospital, 0 in 250,000.

These statistics and others quoted in the literature are those of excellent maternity centers. They do not, however, give a true picture of the condition as compared with statistics, were they available, of patients who are delivered in their homes by men less skillful and less experienced in the art of obstetrics. It is a known fact, however, that this disorder is becoming less frequent as the standard of practice is gradually raised.

Spontaneous uterine inversion may occur, but prevalently one of three factors, or a combination of them, is necessary in the development of this complication of childbirth. These factors are (1) undue relaxation of the uterine wall, (2) pressure on the fundus from above, and (3) traction on the funis from below. The Credé expression on a relaxed uterus or before placental separation, the erect posture in labor, a short cord, straining of the abdominal muscles during labor, coughing, sneezing, fundal implantation of the placenta, and the pressure of submucous myomas during pregnancy, all play a rôle in the etiology.

Primiparæ are more disposed to this complication of labor than multiparæ, since, in the former, the placenta is usually inserted nearer the fundus and also because of the greater vigor of the uterine muscle during a first labor. If uterine inertia alone were the cause of inversion it would be found more commonly in multiparæ, in whom this disorder is more frequently encountered.

The mechanism of uterine inversion is well described by Jones as follows: "After any portion of the uterus becomes indented to a considerable extent, the rest of the organ seizes this invaginated portion as it would grasp a foreign body, and, in attempting to expel it, turns itself inside out."

The symptomatology varies in extent with the degree and the acuteness of the condition. Those patients in whom the inversion is acute suffer profound shock, hemorrhage, and pain, while those with chronic lesions complain of backache, bearing down pain, vesical and rectal tenesmus, anemia from continuous loss of blood, and signs of low grade infection.

The diagnosis is not difficult if one has this pathological entity in mind, yet, one of my patients had been under the daily observation of two physicians for 2 months and the diagnosis had not been made. Obviously, the diagnosis is established largely by examination. In obstetric inversions inspection by means of a speculum reveals a soft, pear-shaped tumor with the broad surface downward, filling the vagina. The uterine mucosa presents on the surface of the mass. This may be dark red or mahogany brown in the early stages and grayish in color in the advanced stages. On bimanual examination the fundus is missed in its normal position and there appears a crater-shaped or cup-shaped depression in its stead. The rectal examination is of value in the location of this depression. The indentation produced by inversion is characteristic and is absent in other lesions considered in the differential diagnosis.

Read before the American Association of Obstetricians, Gynecologists, and Abdominal Surgeons, Hot Springs, Virginia, September 7 to 9, 1939.

Before the days of aseptic surgery the mortality among patients with acute inversion was in the vicinity of 80 per cent. A review of the literature in 1925 led me to state that the mortality in acute inversion was approximately 34 per cent, and in chronic inversion about 6 per cent. At the present time the mortality rate in inversion of the uterus averages between 5 and 10 per cent. Death is ascribed to hemorrhage, shock, and sepsis. The attempt to reduce the uterus during the state of shock is an important contributing factor. Blood transfusions have rendered the greatest service in combating hemorrhage and shock. By the same token the patient is less exposed to sepsis because of her improved general condition. The mortality rate is still further reduced by the avoidance of any operative procedures or replacement until the patient is out of her shock and until she has been fortified against the ordeal which she is about to undergo. The treatment may be conservative or operative. The non-operative methods consist of manual reposition and pressure applied to the fundus from below by means of colpeurynters which are sometimes filled with mercury, the gauze pack, and elastic pressure.

The operative procedures may be carried out through the abdomen or through the vagina. For the patient in whom inversion is recognized moderately early, whose condition is classified as subacute, and in whom manual reposition cannot be carried out, the abdominal operation proposed by Huntington, in 1921, whereby the ring is dilated from above through an abdominal incision and successive portions of the uterus are picked up below the crater by a series of Allis forceps until the uterus is reinverted, has proved efficacious. The operation of Haultain, in which, after the abdomen is opened, an incision is made in the middle of the posterior portion of the constricting ring and the uterus is replaced by pressure through the vagina, should also receive consideration. The incision, which is about an inch (2.5 centimeters) or at most 2 inches (5 centimeters) in length, is found in the lower uterine segment, on its posterior surface, after the uterus is reposed. This incision is usually closed in 2 layers with catgut and the uterus is generally suspended by the round ligaments. This incision, placed in the lower segment, has an added advantage in that it interferes but little with future childbearing. The other abdominal operations consist of dilatation of the cervical ring from above and the reposition of the uterus from below, with or without preliminary incisions. Abdominal hysterectomy becomes necessary in the presence of serious pathological changes in the uterine musculature.

Because of its greater safety most surgeons choose the vaginal route in the treatment of chronic inversion. The choice rests between anterior colpohysterotomy (Spinelli operation) and posterior colpohysterotomy (Kuestner operation) when the uterus can be conserved, and vaginal hysterectomy when the opposite obtains. Vaginal hysterectomy finds its greatest field of usefulness in the treatment of gangrene of the uterine corpus. In America, at least, the Spinelli operation is the one which is most frequently chosen for the treatment of chronic inversion when the uterus can be retained.

Since 1924, during a period of 15 years, I have treated 5 women who suffered from puerperal inversion of the uterus. The conditions 2 of these patients presented were classified as acute inversions and 3 as chronic. Two of the patients were on my service and 3 of them were seen in consultation. In one patient who was seen immediately after the accident, the placenta was removed from the fundus of the inverted uterus and the organ was replaced manually without any special difficulty. Another, admitted with gangrene of the uterus after attempts at reposition had been made elsewhere, was treated by the Haultain method followed by abdominal hysterectomy, while the 3 others had Spinelli operations. All patients recovered. Brief abstracts of the case histories of these patients follow.

CASE 1. Mrs. M. D., 27 years of age, a secundigravida, was delivered at the Carney Hospital on June 27, 1924, by a staff member. Her first stillborn child, because of toxemia, was delivered at 8 months of pregnancy. Except for a moderate albuminuria there were no other complications during the present pregnancy. Her pelvis was ample. She was given 0.5 cubic centimeter of posterior pituitary extract at the full dilatation of the cervix and was delivered by low forceps of a normal female child, who weighed 8 pounds, 6 ounces (3,819 grams). The placenta, which was inserted at the fundus, was firmly adherent and in attempting the Credé maneuver the attendant inverted the uterus. The placenta was peeled from the fundus, the uterus was reinverted manually and was packed with sterile gauze. One cubic centimeter of an ergot preparation was administered intramuscularly. One hour after labor the uterus was flabby and signs of a slow and persistent hemorrhage were observed.

I saw the patient 4 hours after delivery, while making hospital rounds. She was then pulseless, was bleeding freely, showed signs of air hunger, and her condition looked desperate. Half an hour later she was given 1000 cubic centimeters of normal saline solution subpectorally. Two and a half hours later she was given a blood transfusion of 600 cubic centimeters by the citrate method. Her condition rapidly improved and she was discharged from the hospital by her obstetrician on July 13, 1924, after an otherwise uneventful puerperium. A pelvic examination was not made at the time of discharge, so no note was made as to the condition of the uterus. One week after her discharge I saw her in her home in consultation with her physician, who felt he had discovered a uterine prolapse. Because of

the lack of aseptic conditions, I preferred to do the internal examination in the hospital and advised that she come there at once. My advice was not taken, however, as she did not report until July 29, 1924, at which time examination revealed the typical findings of a chronic inversion of the uterus. The uterine mucosa was grayish in color. A Spinelli operation was performed on July 30, 1924. The postoperative course was febrile, the temperature having risen to 102 degrees F. She was discharged on August 16, 1924, at which time the uterus was found in midpelvis, the anterior and posterior drainage tracts were healed and there was no pelvic tenderness. Her menstruation was resumed in September, 1924, and became regular. On April 8, 1925, she was admitted to the medical service of the Carney Hospital, where a diagnosis of chronic fibroid phthisis was made. On July 25, 1925, she was living in the country, her tuberculous process was arrested, she was gaining in weight, and was feeling well.

CASE 2. Mrs. N. F., 33 years of age, a secundipara, was seen in consultation in a private hospital in Boston on April 25, 1927. She had had 2 children, who were living and well, and no miscarriages. The first child was delivered with medium, and the second with low, forceps. The second child was born on February 6, 1927, and the attending physicians had not been impressed by any difficulties with the third stage of labor. Although the vagina had been packed several times for hemorrhage they had not recognized the inversion. The diagnosis was established on April 25, 1927, 78 days after delivery. On this day, under general anesthesia, a Spinelli operation was performed, and anterior and posterior drains were introduced. The patient was in good condition upon leaving the operating table. Two days later, April 27, 1927, she was given a blood transfusion of 500 cubic centimeters by the citrate method. The convalescence was febrile, but the incisions healed satisfactorily. At the time of her discharge, 3 weeks after operation, the uterus was found in midpelvis, the drainage tracts and incisions were healed, there were no masses or areas of tenderness in the pelvis, and her condition was satisfactory.

CASE 3. Mrs. L. C., 29 years of age, a tertigravida, was admitted, in labor, to the Carney Hospital on March 3, 1928. Her first pregnancy had terminated in a miscarriage at 3 months of gestation and her second in a normal delivery in March, 1927. The present pregnancy evolved without any complications; she had had adequate prenatal care, her labor lasted 10 hours, and there had been no lacerations. The well formed female child was delivered and cried spontaneously. During an attempt at the Credé maneuver, the interne in charge of the labor completely inverted the uterus, with the placenta implanted at the fundus. I saw the patient very shortly after the accident. Under general anesthesia the placenta was peeled from the uterine fundus and the uterus was reinverted, starting with one cornu, then the next and finally accomplishing the total reinversion. The uterus contracted well and remained in satisfactory position. Since there was considerable shock, a subpectoral infusion of 1700 cubic centimeters of normal saline solution was administered. The patient readily came out of shock and a blood transfusion was not necessary. The puerperium was afebrile, and normal in all respects. Mother and baby were discharged in excellent condition on March 15, 1928. The involution of the uterus had progressed normally and there had been no undue loss of blood during the puerperium.

CASE 4. Mrs. L. M., 29 years of age, a very obese tertipara, was admitted to the Carney Hospital on February 5, 1931. She had had 2 previous labors, the first terminated instrumentally in 1928 and the second normally in 1929. Considerable difficulty with the placental stage had been encountered in the latter pregnancy. At 8:30 p.m. on February 2, 1931, at the end of her third pregnancy, she was delivered of a healthy infant at the Marlboro Hospital. Although the delivery was normal, there was considerable difficulty with the third stage, which was followed by a severe hemorrhage. On February 5, 1931, an inversion of the uterus was recognized, and an attempt was made to reinvert it. This was, however, without success. When I was called I advised that the patient be sent to the Carney Hospital, where she arrived at 3:30 p.m. She was then blanched, the uterus was necrotic, gangrenous, and a very foul odor escaped from the vagina. The vulva was ecchymotic and edematous, the perineum had been freshly lacerated as far as the sphincter, and the vagina was purplish black in color. The hemoglobin was 38 per cent and the red cell count 2,140,000. A blood transfusion of 600 cubic centimeters was administered by the citrate method, her husband acting as donor. Since she had a mild upper respiratory tract infection, spinal anesthesia was decided upon. This was difficult of administration because of her obesity, and an extra long needle was used. The abdomen was prepared with ether and half strength tincture of iodine. The patient was placed in the Trendelenburg position and a median suprapubic incision, which extended from the symphysis to the umbilicus, was made. The intestines were walled off from the pelvis with gauze. The bladder was found to have been pulled upward and to contain a moderate amount of urine even though the patient had been catheterized before she was taken to the operating room. The bladder was again emptied by catheter. On examination, the crater of the inversion presented, and the tubes and ovaries were drawn into it. The ring was about 3 to 4 centimeters in circumference. The infundibulopelvic ligaments were ligated and cut. The cervical ring was incised posteriorly, in the median line, and thus the vagina was opened; the posterior wall of the uterus was then incised sufficiently to pick up the sides with vulsella and reinvert the organ (Haultain operation). The uterus was then wrapped in a sterile towel and another such towel was spread over the pelvis. The round ligaments were ligated and cut. The bladder was next freely separated from the cervix and vagina, and the uterine and vaginal vessels were clamped, cut, and ligated. The vagina was then cut in such a way that the circular incision met the posterior one already made; thus the gangrenous uterus and adnexa were removed. A 1 yard wick of iodoform gauze was packed in the vagina, the end of which was left in the peritoneal cavity. The anterior and posterior leaves of peritoneum and the peritoneal edge of the bladder were approximated around the drain to cover over all raw areas. After a change of gloves, the towel and walling off strips were removed from the pelvis, the sigmoid was led into it, the omentum was brought down to cover the intestines, and the abdominal wall was closed in layers. The patient stood the operation well and there was practically no bleeding. A second transfusion of 600 cubic centimeters of blood by the citrate method was administered, after which she was returned to bed in excellent condition. At this time her brother-in-law was the donor. The convalescence was febrile. The highest temperature was 102 degrees F., pulse 130, and respirations 30 on the second postoperative day. The temperature, pulse, and respirations then gradually dropped to normal. She was discharged from the hospital on February 24, 1931, 19 days after admission, in good physical condition. On April 6, 1931, she was examined at the office. The abdominal incision was found to be well healed, without induration or tenderness. Vaginal examination showed a deep laceration of the perineum but no cystocele or rectocele. Vaginal vault was healed and well supported in the pelvis; no bulging on hard straining. Patient well and had resumed household duties.

CASE 5. Mrs. M. B., 30 years of age, a secundipara, was admitted to the Carney Hospital on May 25, 1938. She had had 2 children, both delivered with forceps, the last infant having been born 10 weeks before admission. For 7 days preceding admission there had been a constant brownish discharge and hemorrhages, the hemorrhages being especially severe when straining at stool. It was found on examination after admission that the vagina was filled with blood clot, the equivalent of 2 handfuls. After the evacuation of the clots a puerperal inversion was discovered. On inspection, the striking feature was the marked pallor; the hemoglobin was 45 per cent, the red cell count 2,770,000, and the white cell count 6,200. During the afternoon of May 26, she was given a blood transfusion of 500 cubic centimeters administered by the citrate method. On May 27, 1938, she was operated on, under spinal anesthesia. A typical Spinelli operation was performed. Drainage in the anterior and posterior cul-de-sacs was instituted. A second blood transfusion was started as soon as she was returned to her bed. Again, the citrate method was used and 500 cubic centimeters of blood was given, a total of 1000 cubic centimeters being transfused. She stood the operation well. The convalescence was mildly febrile, the temperature was 102 degrees F., pulse 130, and respirations 34 on the first postoperative day, but all three were normal by the tenth day. She was discharged from the hospital on June 11, 1938, 17 days after admission, at which time her condition was entirely satisfactory. On July 18, 1938, she was examined at the office. The abdomen was soft, relaxed, tympanitic, and there were no masses or areas of tenderness. The perineum was relaxed, the cervix was healed, the uterus was normal in size, in second degree retroversion, and the adnexa were normal. The cervix, as seen through the speculum, showed good healing. The drainage areas, as well as the anterior vaginal incision, were healed. There was no cystocele or rectocele, the blood picture was normal, and the operative result was entirely satisfactory.

SUMMARY AND CONCLUSIONS

1. Puerperal inversion of the uterus is a rare condition. With constantly improving practice it will become even less frequent.

2. The predisposing factors in the etiology are inertia of the uterus, pressure on the fundus from above, and traction on the cord from below.

3. Shock is the leading symptom, and when this occurs after the third stage of labor uterine inversion should be suspected.

4. In acute cases the uterus should be reinverted manually when possible, as soon as the condition is discovered (Case 3). In cases in which this is not possible, laparotomy and reposition by taxis are the procedures of choice.

5. Chronic inversion of the uterus is well treated by the vaginal method; anterior colpohysterotomy (Spinelli operation) is performed when the uterus can be saved (Cases 1, 2, 5). Vaginal hysterectomy is the operation of choice when the opposite is true.

6. Abdominal hysterectomy may be resorted to when previous attempts at reduction have been made and the vagina is in such bruised, ecchymotic condition that it is impossible to recognize any landmarks to operate through it (Case 4).

7. Shock and hemorrhage should be combated by blood transfusion before any operative procedures are attempted. This precaution has considerably reduced the mortality during recent years.

8. The obstetric future of the woman who has had a Spinelli operation should be that of one delivered by means of a previous classical cesarean section.

9. Five personal cases of patients with puerperal inversion are reported, 1 was treated by manual reposition, 1 by an abdominal panhysterectomy with bilateral salpingo-oophorectomy, and 3 by the Spinelli operation. All patients recovered.

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EDITORIALS

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RATIONAL TREATMENT OF URETERAL STONE

MODERN methods of treating stones in the ureter by manipulation constitute an important advance in urological practice. However, they undoubtedly have limitations and when employed injudiciously are not devoid of danger. Stimulated by Crowell's report in 1921 of the removal of 88 stones in a series of 95 cases by cystoscopic procedures, many urologists have developed instruments and methods for the non-operative removal of ureteral calculi, and this has led some to develop excessive enthusiasm for these methods.

It is a well recognized fact that many stones will pass unaided if permitted to do so and that others will require removal by operative means, despite attempts by manipulation to facilitate their passage. The wise choice of the most suitable method of treatment is of the utmost importance to the patient with an obstructing ureteral calculus, and may not only save him from serious renal damage but also from much suffering.

Such factors as the size and shape of the stone, its position in the ureter, and its mobility must be considered. Very small stones will usually pass spontaneously, or after a simple manipulation, while very large stones undoubtedly will require removal by ureterolithotomy. However, the position of a particular stone, together with evidence as to whether it is fixed in one position or is progressing down the ureter, is of greater importance than the actual size of the stone in most instances. Stones are usually arrested at the natural points of narrowing of the ureter, the ureteropelvic junction, the brim of the pelvis and at its entrance into the bladder. Their arrest at other points may be considered as evidence of stricture or other obstruction to their passage. Further, stones located in the lower portion of the ureter are more amenable to removal by manipulation than those located above the brim of the pelvis. Operative removal in the pelvic portion is often exceedingly difficult, while ureterolithotomy in the upper two-thirds of the ureter is usually a simple operation attended with little or no risk. Therefore, more persistent attempts at non-operative removal are justified in the portion of the ureter immediately above the bladder.

In addition to these problems, it is necessary to consider the risks of each procedure. Removal of a stone by manipulation is often termed "conservative" and by ureterolithotomy as "radical" treatment. Are these cystoscopic manipulations conservative in all instances? If those stones which would pass spontaneously are excluded, probably 60 to 80

per cent may be assisted in passing by manipulation, and the remainder will require surgical removal. The problem of when to attempt the removal of a stone by manipulation and how long to persist in the use of this method, together with the choice of instruments and procedures, undoubtedly require much experience and good judgment.

Trauma to the ureter due to a poor choice of instrument or lack of gentleness, has led to serious complications even requiring the ultimate loss of a kidney by nephrectomy. Bumpus has pointed out that no instrument should be employed for the extraction of a stone, which cannot be withdrawn from the ureter without difficulty after it has engaged the stone. This is an excellent rule to follow. Instruments of the spiral or corkscrew type can always be reversed so as to disengage a stone which is too large to be pulled down the ureter with safety. Many experienced urologists have ceased to employ, except rarely, any of the mechanical stone extractors and rely upon adequate dilatation of the ureter by tapered ureteral bougies and by the passage of multiple ureteral catheters, which may be allowed to remain in the ureter for twenty-four hours. Fever, pain in the loin, and other evidence of renal infection, whether occurring independent of manipulation or following such procedures, usually indicate that immediate surgical removal of the stone is imperative. Failure to relieve promptly the obstruction with the resulting back pressure and inflammatory process will lead to irreparable damage to the kidney.

Each surgeon should endeavor to assess all the clinical factors applicable to each patient, together with the factor of his own personal training and experience, and thus choose wisely the method most suited to the particular patient. By so doing, he will assist in the passage of the stone in many instances by cystoscopic manipulation, and in others in which these methods are unsuitable will by early operation save many patients from long periods of suffering, anxiety and prolonged invalidism and from irreparable renal damage.

GORDON S. FOULDS.

TOTAL GASTRECTOMY IN GASTRIC CANCER

CANCER of the stomach, according to Livingston and Pack, has killed nearly one-third more individuals in fifteen years than the traffic fatalities in this country over a similar period of time. All the wars of the United States have totalled only fifteen years, but fifteen years of gastric cancer deaths have totalled about two and a half times as many as all our war fatalities.

At present surgery offers the only means by which cancer of the stomach can be treated successfully. Unfortunately, however, the disease is already so far advanced in most patients that come to the surgeon that only from one-fifth to one-fourth of the tumors can be resected with any hope of eradicating all grossly involved tissue. Obviously it would improve the situation to educate the public to consult a physician promptly when dyspepsia develops, to educate physicians to provide competent roentgenological examination of such patients without delay and to suspect cancer in any gastric ulceration that does not heal quickly when treated vigorously. Such education, however, appears to be slow and discouraging and in the meantime the surgeon is faced by the reality of making the best of a bad bargain.

While the results of operation for gastric cancer by the average surgeon are quite disheartening, both as regards operative mortality and later survival rate, Livingston and Pack have shown that the better qualified sur-

geons in this country and abroad have attained notable success in the resectable group of gastric cancers. "Fifty per cent five-year definitive cures for patients with gastric carcinoma without invasion of lymph nodes at the time of gastrectomy, 55 per cent ten-year cures for patients having removal of grade I and grade II cancers, and 20 per cent ten-year cures for unselected types of resectable gastric cancer treated by excision (which signify, respectively, a 60 per cent, 80 per cent, and 30 per cent approach to the maximum attainable survival rate for the age group treated) constitute a degree of success which exceeds that attained in the care of any form of strictly internal cancer, and approximates or equals that obtained in the management of many external or readily accessible varieties of malignant tumors." It must be emphasized, however, that these figures represent the results obtained not by the average surgeon but by a comparatively small group of surgeons working under the best conditions. The facts indicate clearly the desirability of placing the patient with cancer of the stomach in the care of specially trained surgeons and properly equipped institutions. There would be thereby an immediate decrease in operative mortality and a marked increase in the later survival rate. Any further advance must then come through improvement in resection itself.

Improvement in the results of the surgery of cancer has always followed increasingly radical operation. The more widespread the removal of a tumor and adjacent tissues in which it may spread the greater the chance for prevention of recurrence through tumor cells that are present though not grossly evident in the tissues beyond the line of resection. In the stomach the blood and lymph channels form such a complex network that each part of the organ has vascular and lymphatic connection with every other part. Study of tissues removed at operation and necropsy often reveals the presence of tumor cells microscopically evident far beyond the limits of the grossly demonstrable tumor. Furthermore, the patients that die of a recurrent cancer following partial gastrectomy frequently develop the recurrence in the stump of the stomach.

Carried to its ultimate conclusion the ideal procedure for the surgical treatment of cancer of the stomach should be total gastrectomy, including as much duodenum and as much of the adjacent lymph bearing tissue as possible in all instances in which such a procedure is technically feasible and pathologically effective in removing all grossly involved tissue.

Total gastrectomy has been done often enough and by a sufficient number of well qualified surgeons to establish a feasible and reasonably safe and standardized technique for its consummation. Roeder in 1933 reviewed a total of 88 instances of the operation and Allen in 1937 reported a series of 15 and commented upon the fact that "the operation has become quite commonplace." The tendency of some individuals to develop anemia after total gastrectomy seems to be satisfactorily controllable by diet and other forms of treatment. There seems to be no obvious reason why one should not live indefinitely without a stomach. While the operative mortality of total gastrectomy is now relatively high, this fact must be somewhat discounted by the circumstance than at present total gastrectomy is performed as practically a last resort in only those patients with extensive local disease and marked secondary systemic effects. Likewise the prognosis and morbidity have been based upon the same group of patients, those in whom the outlook was hopeless by any other treatment than total gastrectomy and not much more hopeful after it had been done.

It would seem that total gastrectomy should be worthy of a trial by properly qualified surgeons in the earlier, less extensively involved cases of gastric cancer rather than being reserved for only those patients with very extensive or total involvement of the stomach. The operation would appear to be especially indicated in the younger group of individuals with tumors in the higher grades of malignancy. The operative mortality should be minimal in this group and the prolongation of life maximal in those that survive the operation with complete eradication of the tumor.

Even at best, of course, because of inherent technical difficulties the field for total gastrectomy must remain more or less restricted. And until more frequent use and greater experience still further standardize the technique the operative mortality will remain higher than that of partial gastrectomy. There would seem to be good reason to believe, however, that in the hands of properly qualified surgeons, improved morbidity after total gastrectomy should more than counterbalance the immediate mortality of the operation.

CHARLES BRUCE MORTON.

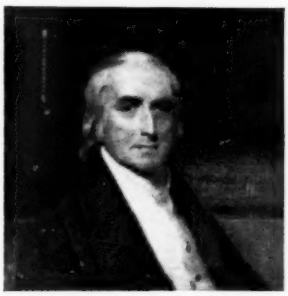
TEXTS AND DOCUMENTS

ARNO B. LUCKHARDT, M.D., Chicago, Illinois

DR. PHILIP SYNG PHYSICK (1768–1837) was a native of Philadelphia where he also practiced surgery for some forty-six years. He practiced general surgery which at that time meant every field from lithotomy to lens extraction. Because of native mechanical ingenuity he devoted himself by choice to what would now be spoken of as the orthopedics.

His literary contributions of a medical or surgical nature are not numerous. Had they been he would have definitely assured himself priority for several surgical innovations and successes. What his bibliography lacks in literary poundage it makes up, with all its brevity, in classical contributions of lasting scientific merit. Because some of the latter are buried in journals which have suspended publication a long time ago, it seemed appropriate to reprint two of them at this time in order to save from oblivion the physician who has been given the epithet of "The Father of American Surgery." Both contributions can not fail to interest every medical man but undoubtedly the second one on absorbable sutures will be of particular interest to surgeons.

From the Department of Physiology, University of Chicago.



PHILIP SYNG PHYSICK, M.D.
1768–1837[1]

Reproduction of an engraving by R. W. Dodson from the original picture by H. Inman painted for the Medical Class of the University of Pennsylvania.

There being no intention to write a biographical sketch of Dr. Physick, brilliant pupil of John Hunter and friend of Benjamin Rush, a few bibliographical references to such biographies or biographical sketches will be appended where the particularly interested reader can find an account of his life, together with his other memorable contributions to medical practice.[2]

The reproduction of the first original paper might well be prefaced by this statement:

In spite of the attempt by its author to attribute to Dr. Alexander Monro tertius, as an "act of justice," the discovery and use of a stomach tube for purposes of washing out the stomach in cases of poisoning from ingested drugs or of administration by this means of antidotal drugs, medical posterity has by universal consent given Dr. Physick full prior credit for the discovery of this important therapeutic measure.

For completeness' sake both the memoirs and the subsequent open letter on this subject now follow:

[2] A Memoir on the life and character of Philip Syng Physick, M.D., by J. Randolph, M.D., Philadelphia, Printed by T. K. and P. G. Collins, 1839, p. 114; Necrological notice of Dr. Philip Syng Physick by W. E. Horner, M.D., Philadelphia, Barrington & Haswell, 1838, p. 22; Philip Syng Physick, Jour. of Organotherapy, pp. 21, 23 & 24, yr. not known; Philip Syng Physick by Mortimer Frank, Interstate Medical Journal, vol. XVII, No. 9, 1910, pp. 1–3.

ACCOUNT OF A NEW MODE OF EXTRACTING POISONOUS SUBSTANCES FROM THE STOMACH[1]

By PHILIP S. PHYSICK, M.D., Professor of Surgery in the University of Pennsylvania, Surgeon of the Pennsylvania Hospital as of 1794

ON Thursday 6th June, 1812, I was sent for in much haste at nine o'clock in the evening, to visit two children of Mr. S. B. each three months old. They were twins, and had been affected with hooping cough for several weeks. The mother informed me that in consequence of her children having been very restless the night before, she had this evening given them some laudanum. To William she had given one drop at seven o'clock, and the same dose to Edmund forty minutes afterwards.

I found William in a state of stupor or very profound sleep, from which he could not be roused, and was informed, that just before my arrival, his whole body had been strongly convulsed; his breathing was laborious and his pulse feeble and slow. On inquiry, I found that the vial out of which the drop of laudanum had been given, had contained, several weeks before, nearly one ounce of that medicine, but having been left without a cork, it had dried away so much that one drop only could be obtained for William; in order to procure another drop, two drops of water had been put into the vial and stirred about, by which another drop had been obtained and given to Edmund, forty minutes having intervened between the two doses.

About a quarter of an hour before my visit, the mother had given to William fifteen drops of antimonial wine, but as it had produced no effect I prescribed an emetic of ipecacuanha, and directed it to be given immediately; this however was found impracticable, as the child was incapable of swallowing.

At half past nine o'clock, Edmund, who had appeared to be in a very easy sleep, became convulsed, and his pulse and breathing were affected in the same way that his brother's had been. We attempted to give him ipecacuanha, but could not make him swallow it. The countenances of the children became livid,—their breathing very laborious; with long intervals between the times of each inspiration, and the pulse in each very feeble.

Under these circumstances it clearly appeared no time was to be lost, and therefore, as they could not swallow anything, I determined to inject an emetic into their stomachs. For this purpose a large flexible catheter was passed through the mouth down the æsophagus into the stomach, and through this, one drachm of ipecacuanha mixed with water was quickly injected by means of a common pewter syringe. In hopes that the emetic would operate, I waited some time without any effect being produced. William exhibited now every symptom of speedy dissolution,—his face became very livid;—the pulse and respiration had almost ceased; and indeed the pulse could not be perceived, except a faint stroke or two, after that kind of imperfect and convulsive inspiration which is commonly observed in children just before actual death, accompanied with a convulsed action of the muscles of the mouth and neck. In this situation I passed the catheter again, and by applying the syringe to its projecting end, drew up the fluid contents of the stomach, and immediately injected warm water which was again withdrawn[2]. These operations were alternated two or three times, but when completed no sign of life remained. Hopeless as the case now appeared, I injected some spirit[3] and water mixed with a little vinegar through the catheter;—in less than one minute the child again inspired, the pulse became perceptible at the wrist, and in four minutes, with the aid of external stimuli, both went on so per-

[1]The Eclectic Repertory & Analytical Review, vol. III, Philadelphia. Published by Thomas Dobson, 1813, pp. 111–114.

[2]The idea of washing out the stomach with a syringe and tube, in cases where large quantities of laudanum or other poisons had been swallowed, occurred to me at least twelve years ago, and I have constantly, for many years, recommended it in my lectures. In the year 1809, Dr. Dorsey performed the operation of washing out the stomach in such a case, but the patient had taken the poison twelve hours before he was called, so that he did not succeed. Since writing the above, I have been informed that in an European journal, a French surgeon has lately proposed injecting the stomach. My informant has unfortunately mislaid the pamphlet.

[3]See Medical Repository, volume 5, page 347.

fectly that there was every reason to believe the child would recover.[1]

By the time that these operations were performed on William, Edmund was observed to have passed into the same condition of apparent death, from which his brother had just recovered. The same measures were adopted in his case, and with the same happy effect. I now flattered myself that the children would do well, but in this expectation I was disappointed. In about half an hour, Edmund's breathing became very slow and laborious, and his pulse which had before been very much excited became so feeble, that he appeared to be sinking very fast. Supposing that the effects observed might be produced by the spirit which had been given, occasioning intoxication, I determined to extract it from the stomach and to inject warm water, removing it again. This operation was very quickly performed, but at the conclusion of it I was much distressed by seeing the little patient to all appearance lifeless. Observing in this case, that the actions of life ceased so immediately after the extraction of the spirit, I determined to try it again, and injected a little weak brandy and water. In less than a minute this occasioned a repetition of breathing and of the action of the heart, and in about five minutes both were regularly performed. The symptoms of ebriety took place also in William, but observing that his brother had been nearly lost by extracting the spirit from his stomach, I did not attempt the removal of it in William's case.

Doctor Austin who kindly assisted me on this occasion, remained all night with my little patients. He informed me, that after some time they became better, though they both had slight convulsive motions occasionally through the night. Their bowels were moved several times by castor oil. After five o'clock in the morning Edmund had no convulsions, but they continued with William until twenty-five minutes after nine, when he struggled a little, sighed, and expired. Edmund was troubled for two or three days with a diarrhaea, but soon recovered completely.

[1] It might be suspected, that the catheter passing through the fauces, would endanger suffocation from its situation over the top of the larynx, but this was not the case, because the children recommenced breathing before the instrument was removed. I found also with my finger, that the instrument rested on one side or other of the epiglottis, so that it could not obstruct the glottis.

To the Editors of the Eclectic Repertory

(*An Open Letter*)

Gentlemen,

When I sent you the communication published in the first number of the third volume of the *Eclectic Repertory*, descriptive of what I supposed a new method of extracting poisons from the stomach, I was influenced by a desire to propose to my medical brethren a method of treatment which might preserve the lives of many unhappy persons, who either by design or accident had swallowed large doses of laudanum or other poisonous substances. If in a single instance I had been instrumental in preventing death, I should have considered myself very happy; and to have withheld a communication which might have been attended with such beneficial effects, would have been in every respect unjustifiable.

I have the pleasure of announcing to you and to your readers, that in several instances which have recently occurred in this city, the practice has been completely successful.—In two cases treated by Dr. Dorsey, in which large quantities of laudanum had been taken, there is great reason to believe that no other mode of treatment would have succeeded in preventing the fatal event. Both patients were saved by injecting warm water into their stomachs, and extracting it again, together with the laudanum, by means of a syringe.

I therefore am happy in having called the attention of the profession to a mode of treatment not before used in this country, at least within my knowledge; but I have now an act of justice to perform, in ascribing the merit of the invention to Dr. Alexander Monro, junior, of Edinburgh, who published it in his inaugural thesis, in A.D. 1797. Of this circumstance I was entirely ignorant when I sent you my paper, and probably should still have remained so, had it not been mentioned in his book of Morbid Anatomy, a work which has but very lately come into my hands.

Very respectfully, I am,
gentlemen, yours, &c.
PHILIP SYNG PHYSICK,

Philadelphia, 20th January, 1813.
(loc. cit.) p. 380-381.

MEDICAL AND PHILOSOPHICAL INTELLIGENCE FOR THE *ECLECTIC REPERTORY*

The importance of the second brief contribution requires no introduction except perhaps the remark that Dr. Physick has been unintentionally neglected in a recently published beautifully executed series of historic and pictorial dramatizations on surgical suture material over the centuries.

The Editors [Eclectic Repertory, vol. 6, 1816, pp. 389-390] are pleased to have it in their power to lay before their readers the following interesting Communication from Dr. Physick, which has just been handed to them. Had it been sooner received it would have occupied a more appropriate place in this Number.

HAVING repeatedly experienced considerable delay in the healing of wounds from ligatures applied on divided arteries remaining a long time in the sore before they could be removed, I have for many years been very desirous of avoiding such an inconvenience in the use of ligatures. With this view, the first idea that occurred was that of drawing the ligature tight on the vessel by the assistance of a double canula: unfortunately, the first patient on whom it was employed for securing the femoral artery, died of tetanus; and though I by no means believe the disease to have been occasioned by the instrument, yet the event discouraged from further trials of it.

Several years ago, recollecting how completely leather straps, spread with adhesive plaster, and applied over wounds for the purpose of keeping their sides in contact, were dissolved by the fluids discharged from the wound, it appeared to me that ligatures might be made of leather, or of some other animal substance, with which the sides of a blood-vessel could be compressed for a sufficient time to prevent hemorrhage; that such ligatures would be dissolved after a few days, and would be evacuated with the discharge from the cavity of the wound.

Under this impression, I requested Dr. Dorsey[1] to try the experiment on a horse, by using a ligature of buckskin. This was found to answer every purpose, and came away in a few days.

This fact was mentioned at the time to several of my medical acquaintance; and I understand that Dr. Hartshorne has lately tied up some of the arteries after amputating the thigh, with ligatures of parchment. They were found dissolved at the first dressing. Dr. Dorsey, in several operations, in which I have assisted, has used ligatures of French kid, which he finds stronger than any other leather. He has it cut into narrow strips, stretches them and peels off the coloured polished surface. No hemorrhage has taken place in any instance, and the ligatures are found dissolved at the end of two or three days.

With the view of ascertaining what animal substance would withstand the solvent power of pus for the longest time, I suggested the plan of trying different articles, by applying them over the surfaces of ulcers. Buckskin, kid, parchment, and catgut, have been tried in this way. The buckskin and kid dissolved first; then the parchment; when at the same time the catgut was but little changed. From an apprehension that in tying large blood-vessels the leather might dissolve too soon, I have requested Dr. Dorsey, to try leather impregnated with varnish used by Mr. Bishop of this city, in making elastic catheters; in the hope that when so prepared it will be somewhat more durable. Perhaps tendon would be found to answer the purpose. Future experiments will probably place at the command of the surgeon a variety of these ligatures, which may be so selected as to remain the exact length of time he may require.

This hasty notice on the subject is given, because it is thought important that these facts should be made public without delay.

P. S. PHYSICK

Philadelphia, July 9, 1816.

[1] Dr. Physick's nephew.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

OCCASIONALLY there suddenly appears a book for which there is an obvious need, one which has an immediate appeal to a definite group of readers, and one which will cause the reader to wonder why such a book has not made an appearance earlier. Just such a book is Hamby's[1] 118 page pocket-size compendium of suggestions for the care of neurosurgical patients.

All too frequently nurses have no special appreciation for the care needed by pre-operative or post-operative neurosurgical patients, and the same can be said for internes and residents on the house surgical staffs of hospitals. Such patients must have a type of nursing care, medication, dressings, and other attention which cannot be carried over from the technique of an ear, nose, and throat, genito-urinary, or fracture service. Since the successful outcome of many neurosurgical cases is directly dependent upon intelligent hospital care, the author has written in concise, uncomplicated, interesting, and practical form a set of instructions to nurses and house officers which is sane, common sense and which is applicable to all neurosurgical patients, regardless of the special technique of various clinics. It is a book that certainly should be on the shelves of every hospital nurses' library and on the desk of every interne under whose care neurosurgical patients come. Incidentally, many of the suggestions written for the care of this class of patients could well be adopted for the care of patients in general surgery whose care, in some hospitals, is often inadequate, antiquated, and irrational.

It is to be doubted whether the brief anatomical introduction to the various chapters is of much value, inasmuch as they are quite brief, and most internes will have at hand more adequate anatomical references. The simple line drawings are effective. Above all, the author has stuck to his original objective, and the result is a happy and useful one.

JOHN MARTIN.

DR. BARNES of the cardiac section of the Mayo Clinic presents in his book *Electrocardiographic Patterns*,[2] his studies of localization of myocardial infarcts by the electrocardiographic method, and ventricular strain, which he has formerly shown in exhibits. The book also contains electrocardiographic material with regard to pericarditis, certain drugs, metabolic disorders, as well as a chapter on Lead IV.

The author presents his studies regarding localization of cardiac infarcts in a very satisfactory manner. The drawings set a high standard of perfection which the electrocardiograms do not quite attain. Although most observers are quite in accord with Dr. Barnes's viewpoint, dissenting opinions are afforded scant mention.

With regard to electrocardiographic changes of right and left ventricular strain there are excellent drawings and typical electrocardiograms. There is considerable question as to whether he proves his point with regard to the diagnostic inferences which can be made from the electrocardiogram to localize heart strain. The shorter bibliographies of these chapters suggest that his ideas have not been completely verified.

Dr. Barnes's presentation of these subjects in book form will be interesting material to many readers.

CHAUNCEY C. MAHER.

IT might seem strange to see a book entitled *Medicine of the Ear*[3] but the practice of otology is changing so rapidly that one no longer looks upon the specialty as purely surgical. Many new phases of treatment and diagnosis have appeared in recent years which are purely fundamental medicine. The general theme of this book is to present diseases of the ear under anatomy, physiology, diagnosis, and non-surgical treatment and to correlate them with operative procedures. Recent contributions to otology have come from the researches of physicists and bio-chemists, physiologists, and pharmacologists, and no present day textbook contains all the latest investigative work. The action of drugs on the vestibular and cochlear mechanisms, and the wide uses of sulfanilamide in otolaryngology are two of the more recent important studies. It was with this thought in mind that a loose-leaf system of medicine of the ear was created. It is a companion volume to *Surgery of the Ear* and possesses many of the same advantages, i.e. it is monographic in style, written with authority and knowledge of the subject, it can be kept up to date by addition of new material, and it is presented in a readable and easily assimilable style.

A special chapter is devoted to the pathology of the labyrinthine capsule because of the fact that otosclerosis is located in the bony shell. For a time

[1] THE HOSPITAL CARE OF NEUROSURGICAL PATIENTS. By Wallace B. Hamby, M.D., F.A.C.S. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1940.

[2] ELECTROCARDIOGRAPHIC PATTERNS; THEIR DIAGNOSTIC AND CLINICAL SIGNIFICANCE. By Arlie R. Barnes, M.D. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1940.

[3] NELSON LOOSE-LEAF MEDICINE OF THE EAR. Edited by Edmund Prince Fowler, Jr., M.D., Sc.D. With a Foreword by John Devereux Kernan, M.D. New York and Edinburgh: Thomas Nelson & Sons, 1939.

histological specimens were rare but due to enthusiastic investigation in various countries, the otic capsule has become one of the best and most carefully examined parts in osteology. Nager has gathered together various specimens of osteoporosis, otosclerosis, osteitis and osteomyelitis and presented them in clear and legible plates, easy to read and easy to understand. The same clear cut expression of the subject is carried out throughout the various chapters dealing with the physiology of the vestibular apparatus, diseases of the middle ear, and diseases of the neural mechanism of hearing. In addition there are chapters on congenital malformations of the ear, inflammation of the external ear and the external auditory canal, the eustachian tube and adjacent nasopharynx, deafness from drugs and poisons, traumatic deafness, tests for hearing, diseases of the vestibular mechanism, management of the deaf and hard of hearing, and the deaf-blind.

The book approximates 600 pages with innumerable cuts and plates, all on good quality paper with clear legible type. There is an excellent bibliography at the end of each chapter. No doubt the volume will find ready use as a consultant on diseases of the ear. JOHN F. DELPH.

NOW in its third edition Dr. Bland's *Gynecology*[1] is a very excellent book on the subject. New chapters have been added on female hormonology and the ovarian endocrine tumors are described and pictured. There are no special chapters on gynecological operations, but each is described in relation to a disease or abnormality as it comes in the text. This is a logical method. Endometriosis is considered separately and a very clear discussion of this interesting lesion is presented. Not all will agree with the belief expressed in a bleeding factor as a cause of abnormal uterine bleeding, or with the term "interval endometrium." The use of radium to check bleeding of an unexplained type in women after the menopause should not be advocated.

This book can be read with great interest and should be of value to surgeons, gynecologists, and general practitioners. Very few statements in it can be challenged. Dr. Bland's book is highly recommended. JOE VINCENT MEIGS.

THE book entitled *Roentgen Technique*[2] by Clyde McNeill deals principally with roentgen anatomy and positioning. Because of the constant changes in the field, very little space is devoted to apparatus or exposure technique. The material is so arranged that on the left hand page one finds a certain position photographically illustrated as well as a line drawing or a reproduction of the resulting roentgenogram while on the right hand page there appears a concise description of the procedure. References have been added for those who wish to do further reading. The addition of charts and drawings on bone development and accessory bones enhances the value of the volume.

Over 100 standard positions are described with reference to simple apparatus available in the average laboratory rather than to the more elaborate and expensive equipment. Roentgenologists, teachers of roentgen technique, and x-ray technicians should find this concisely arranged and practical volume useful in their work. EARL E. BARTH.

THE third edition of *Manipulative Surgery*[3] has been thoroughly revised and extensively rewritten with the addition of new chapters upon "The Cult of Osteopathy" and "The Prevention of Adhesions," and a number of new illustrations.

The author stresses the fact that manipulation is a highly specialized subject. He approaches the subject from his viewpoint as an orthopedic surgeon, and indicates the conditions in which open operation or other measures would yield more satisfactory results than manipulation.

There is also an excellent chapter on the dangers of manipulation in unsuitable cases. However, the author points out that there is a tendency among some to emphasize unduly the dangers of manipulation. This monograph gives an excellent presentation of the great importance and value of manipulation in the treatment in carefully selected cases of certain sequelæ of injuries and diseases, particularly affecting the joints, muscles, tendons, and fascia. It is pointed out that the margin between success and failure in manipulation is often a narrow one, and may depend upon some point of detail, not only in the technique itself but in the after treatment, or even in the psychological approach to the patient.

This monograph can be recommended as giving an excellent and conservative discussion of the controversial subject of treatment by manipulation.
JOHN S. COULTER.

IN the preface to the third edition of *Practical Obstetrics*[4] Bland and Montgomery state that "considerable revision and rewriting" has been done; toxemias of pregnancy, endocrine physiology, obstetrical anesthesia, and treatment of the newborn are the chapters mentioned in this regard.

The 500 illustrations are well selected. Most of them are in black and white, although color has been used for emphasis in a certain number of them.

As in most textbooks the authors' personal views concerning the subject of toxemias are set forth, and the toxemias are classified accordingly; for instance, considerable space is devoted to a differential diagnosis of "simple vomiting" and "pernicious vomiting." The next subject considered is acute yellow atrophy of the liver, then nephritic toxemia, low reserve kidney, giving Standers' clinical criteria for

[1] GYNECOLOGY; MEDICAL AND SURGICAL. By P. Brooke Bland, M.D., F.A.C.S. Assisted by Arthur First, M.D. 3d rev. ed. Philadelphia: F. A. Davis Co., 1939.
[2] ROENTGEN TECHNIQUE. By Clyde McNeill, M.D., Springfield, Ill., Baltimore, Md.: Charles C. Thomas, 1939.
[3] TREATMENT BY MANIPULATION. By A. G. Timbrell Fisher, M.C., M.B., Ch.B., F.R.C.S. (Eng.). Being the 3d ed. of *Manipulative Surgery*. New York: Paul B. Hoeber, Inc., 1939.
[4] PRACTICAL OBSTETRICS. By P. Brooke Bland, M.D., and Thaddeus L. Montgomery, M.D. 3d rev. ed. Philadelphia: F. A. Davis Co., 1939.

this condition; pre-eclampsia and eclampsia are then considered in order.

Under the subject of ablatio placentæ the authors describe Irving's management of the condition, but add that cesarean section with extirpation of the uterus has its place in the treatment of this condition.

The authors' deprecation of Braxton Hicks' version is difficult to understand. Certain environmental and obstetrical conditions make the Braxton Hicks' version the method of choice in the treatment of placenta previa. Its effect on the fetus does not justify its condemnation. Cesarean section is emphasized as a method of management of placenta prævia.

Conservative management is stressed in the management of septic abortion. Habitual abortion is best combatted with vitamin E in the form of wheat germ oil. Progestin has given disappointing results.

The chapter on ectopic pregnancy is excellent. The subject is presented clearly and logically. Emphasis is placed on diagnosis and treatment. The authors state simply that the treatment is surgical. They wisely avoid the mention of "treatment of shock before operation" so frequently found in textbooks.

Normal labor is given generous consideration, its conduct is clearly described, and the subject is well illustrated. Emphasis is placed on obstetrical examination and diagnosis particularly that part dealing with abdominal palpation. Delivery in the presence of abnormal presentation is accomplished in a thoroughly conservative manner. The authors are to be congratulated upon the stress placed upon fundamentals throughout the text. Each phase of obstetrics receives studied consideration. A complete bibliography is contained in the book.

C. C. Doherty.

THE unique x-ray atlas[1], of Kaplan and Rubenfeld, contains 55 full page plates, showing the anatomical position of organs and tissues to be treated and visualized in relation to essential surface landmarks. Each plate shows at a glance the visible surface landmarks, the palpable internal landmarks, the internal part or parts to be irradiated, and the placement of the treatment cone with respect to these landmarks so as to direct the irradiation to the affected area and to avoid the surrounding intervening normal tissues. The book is so arranged that a concise description of the anatomical landmarks, position of the cone and its direction appears on the page opposite each plate. While there may be some disagreement as to certain settings, the topographic drawings will readily apply to any method which the therapist may wish to employ. The material in this atlas is based on the rich experience of the authors at the Bellevue Hospital.

Radiologists should find it most helpful in the teaching and training of young men as well as in explaining their procedures to their colleagues. The atlas will be of interest to any physician who treats disease amenable to x-ray therapy.

Earl E. Barth.

THE second edition of Fifield's[2] well written volume of 260 pages is an admirable and concise presentation of the subject of infections of the hand, and should be a helpful guide to students and practitioners.

An excellent beginning chapter on the anatomy of the hand is followed by a chapter on prophylaxis of infections, and by subsequent chapters—first, on the simple infections, then on infections of the tendon sheaths, of the fascial spaces, on osteomyelitis, lymphangitis, and finally by a chapter on prognosis and on infections from the standpoint of workmen's compensation.

To cite a few points on which one might raise a question concerning the author's advice should not detract from the commendation expressed concerning the volume as a whole. The statement on page 18 that "clinically a connection (between radial bursa and ulnar bursa at the wrist) may always be assumed" may lead to unnecessary incisions in the presence of infection, and to adding injury and further infection in cases in which an infection from the radial bursa had not extended to the ulnar bursa, or vice versa. The horseshoe incision, depicted on page 56, should never be necessary to drain an infection of the distal phalanx. Such an incision always requires a long time for healing and leaves definite disability.

The value of conservative treatment of bone and joint infection has been frequently demonstrated. If the soft tissues are adequately drained, if immobilization is maintained, and if the surgeon persists in cleanly surgical care infection of bones and of joints will often subside and fingers will be saved instead of being sacrificed (page 68).

The incision almost from finger tip to wrist, indicated on page 77 for draining the ulnar bursa, carries a definite risk of dividing completely the digital branch of ulnar nerve to the cleft between the little and ring fingers, and would almost certainly result in long delay in healing and in a deforming and contracting scar. The digital sheath of the little finger can be drained by an incision on the ulnar side of the finger; the main portion of the ulnar bursa by an incision represented by the proximal one-third of the incision advised. The long continuous incision is not necessary.

To drain the middle palmar space one would prefer an incision along the distal flexion crease of the palm rather than the vertical incisions indicated on page 84. The bilateral incisions indicated on page 96 to drain the retroflexor space above the wrist are rarely necessary and tempt the surgeon to insert through-and-through drains—a measure definitely conducive to destruction of tendons and tendon

[1] A Topographic Atlas for X-ray Therapy. By Ira I. Kaplan, B.S., M.D., and Sidney Rubenfeld, B.S., M.D. Chicago, Ill.: The Year Book Publishers, Inc., 1939.

[2] Infections of the Hand. By Lionel R. Fifield, F.R.C.S. (Eng.). Second edition by Patrick Clarkson, F.R.C.S. (Eng.). New York: Paul B. Hoeber, Inc., 1939.

sheaths. An adequate incision on the ulnar side invariably provides effective drainage.

One should repeat that the volume as a whole is well written and the entire subject is admirably presented. The editor of the second edition deserves great credit for his excellent and well illustrated portrayal of the subject. SUMNER L. KOCH.

THE authors of the noteworthy volume *The 1939 Year Book of Radiology*[1] again present an excellent and concise review of the literature dealing with radiology. An unusual amount of material has been obtained from non-radiologic sources and, as stated by the authors, "one must reflect on the possibility that our specialty is being gradually expropriated by other practitioners." A perusal of this book will reveal many significant and outstanding contributions during the past year. Visualization of the chambers of the heart and the great vessels after the intravenous injection of diodrast deserves special recognition.

Although there have been no new or startling discoveries in the field of radiation therapy, one cannot help but be impressed by the vast amount of research which is being done to determine the cause of cancer and its control. More and more new data are being accumulated regarding supervoltage x-ray therapy. A considerable difference of opinion exists as to its value. One gathers the impression that the results thus far do not warrant the replacement of the usual 200 kilovolt unit procedure. There has been continued interest in the use of contact therapy, particularly in the treatment of superficial lesions. The value of irradiation in the treatment of inflammatory conditions is expressed in numerous articles.

This book is recommended without reservation to anyone interested in recent advances in the field of radiology. As in previous years, this excellent volume deserves a place in the library of all radiologists.

EARL E. BARTH.

PROVIDING fundamental knowledge of endocrine physiology and disease in the female, Hamblen's *Endocrine Gynecology*[2] is an excellent book for students and medical practitioners. The basic functions of "intra-uterine growth, birth, postnatal development, sexual differentiation, maturation, sexual activity, and reproduction" are considered. The rôle of the endocrine glands in these processes forms the subject matter of the book.

It is divided as follows: part I, sex-endocrine principles, which provides a thorough review of the hormones with description of the commercial forms available; part II, gynecic physiology, which covers growth, development and adolescence, the female function of maturity including the menstrual and gestational cycles, and the physiology of the climacteric; part III, diagnostic procedures in endocrine gynecology and sex-endocrine syndromes; this and the next section on abnormalities of growth and sexual differentiation are an excellent review of general endocrinology. They are illustrated by exquisite line drawings of examples of the various endocrine syndromes at different ages compared with the normal. Sections VIII and IX take up abnormal uterine bleeding and disorders of menstruation. Section X covers the endocrine aspect of sterility; section XI, the abnormalities of gestation; and section XII, complications of the climacteric. The gross and microscopic pathology of the uterus and ovaries is profusely illustrated by drawings. The study of hormone excretion is thoroughly charted and discussed. Each section has a bibliography.

This work is to be strongly recommended to the pediatrician and internist as well as the surgeon, obstetrician, and gynecologist. PAUL STARR.

THAT a textbook of surgery[3] should pass through five editions in the brief period of 9 years is a tribute to the industry and indefatigability of its author as well as a gauge of its well deserved popularity. We would add our congratulations to the many the author has received, and express again our admiration of his work. To have presented such a mass of material in so attractive and readable a form, to have chosen illustrations that tell their story with a minimum expenditure of space and with no unnecessary flourish, to have provided an interesting background of medical history are achievements that require both scholarship and craftsmanship. To these qualifications there have been added the judgment and discernment that come with years of surgical practice, and the willingness to weigh and consider new methods and new ideas.

The present generation of students and practitioners is fortunate in the men who have made accessible for them the great body of surgical knowledge in such attractive and accessible form, for the textbooks of Homans, Christopher, and Cole and Elman have set a standard that will be a "goal to shoot at" for many years to come.

The jacket of the fifth edition of Homans' textbook lists more than 130 subjects which have been reviewed again with the addition of fresh material, or which represent innovations in the present edition. We have verified the majority of them and agree with the publishers that this new edition deserves unstinted praise. SUMNER L. KOCH.

[1] 1939 YEAR BOOK OF RADIOLOGY. DIAGNOSIS. Edited by Charles A. Waters, M.D., and Whitmer B. Firor, M.D. THERAPEUTICS. Edited by Ira I. Kaplan, B.Sc., M.D. Chicago, Ill.: The Year Book Publishers, Inc., 1939.

[2] ENDOCRINE GYNECOLOGY. By E. C. Hamblen, B.S., M.D., F.A.C.S. Foreword by J. B. Collip, M.D. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1939.

[3] A TEXTBOOK OF SURGERY. By John Homans, M.D. 5th ed. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1940.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

TREATMENT OF DISEASES OF THE PERIPHERAL ARTERIES. By Saul S. Samuels, A.M., M.D. 2d ed. London, New York, Toronto: Oxford University Press, 1940.

THE EARLY DIAGNOSIS OF THE ACUTE ABDOMEN. By Zachary Cope, B.A., M.D., M.S.(Lond.), F.R.C.S.(Eng.). 8th ed. London: Oxford University Press, 1940.

DIAGNOSIS AND TREATMENT OF HEAD INJURIES. By Sidney W. Gross, M.D., F.A.C.S., and William Ehrlich, M.D. Introduction by Percival Bailey, M.D., Ph.D. New York and London: Paul B. Hoeber, Inc., 1940.

UNITED STATES NAVY DEPARTMENT, BUREAU OF MEDICINE AND SURGERY. ANNUAL REPORT OF THE SURGEON GENERAL, U.S. NAVY TO THE SECRETARY OF THE NAVY. Concerning Statistics of Diseases and Injuries in the United States Navy for the Calendar Year 1938. Washington: United States Government Printing Office, 1940.

MINOR SURGERY. By Frederick Christopher, S.B., M.D., F.A.C.S. With a Foreword by Allen B. Kanavel, M.D., F.A.C.S. 4th ed. Philadelphia and London: W. B. Saunders Co., 1940.

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CORRESPONDENCE

RE-ESTABLISHMENT OF GASTRO-INTESTINAL PASSAGE AFTER GASTRIC RESECTION

To the Editor: In a letter in the April, 1940, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, p. 858, Dr. J. Shelton Horsley writes that in my article which appeared in the February 15, 1940, issue under the title "Re-Establishment of Gastro-Intestinal Passage after Gastric Resection" an inaccuracy appears in connection with the mention of his method. I believe that this is a mistake, for the description of Dr. Horsley's operation on p. 275, February 15 issue, tallies completely with that given by him in his textbook as well as in the statement contained in Dr. Horsley's letter. It is one form of end-to-end gastroduodenostomy. In the legend for Figure 1, it is explicitly stated that *d* illustrates the method of J. Shelton Horsley and that *f* illustrates anterior end-to-side duodenogastrostomy as modified by Kocher. It is not an impossible operation as Dr. Horsley seems to think; I have done it myself many times.

EUGENE PÓLYA.

Budapest, Hungary.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE P. MULLER, Philadelphia, *President*
EVARTS A. GRAHAM, St. Louis, *President-Elect*

Committee on Arrangements
JOHN A. WOLFER, *Chairman;* CHARLES B. PUESTOW, *Secretary*

PLANS FOR THE 1940 CLINICAL CONGRESS IN CHICAGO

THE 1940 Clinical Congress of the American College of Surgeons will be held in Chicago, October 21 to 25. This will be the thirtieth assembly of this great organization of surgeons of the United States, Canada and Latin-America. The surgeons of Chicago are privileged to be hosts to the Congress for the eighth time since 1910, when the first large clinical program was organized under the sponsorship of the Clinical Congress of the Surgeons of North America. This year under the leadership of a strong and representative committee, it is planned to present a program of operative clinics and demonstrations covering all phases of the clinical activities of the five medical schools and forty or more hospitals which will participate. Representing, as it does, the interests of all surgical specialists as well as general surgeons, this meeting of the American College of Surgeons will provide a complete and varied program for all of those who will attend. During the five days of the meeting, there will be presentations of the latest advances in diagnostic methods, surgical technique, operative procedure and the aftercare of the surgical patient. Clinics and demonstrations will be held on the afternoon of Monday, October 21, and the mornings and afternoons of each of the four succeeding days.

CLINICAL PROGRAM

An extensive schedule of operative clinics, in which the technique of a wide variety of surgical procedures will be demonstrated in the operating rooms, is being arranged by the committee as the major feature of the Congress. However, the program is being planned, in so far as possible, so that it will also cover related problems in diagnosis, pre- and postoperative care and other special aspects of the management of the surgical condition under consideration.

EXECUTIVE COMMITTEE

John A. Wolfer Chairman	Warren H. Cole
Charles B. Puestow Secretary	Vernon C. David
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	Charles F. Sawyer
	Kellogg Speed

A series of non-operative clinics and demonstrations is being planned which will present the various features of the clinical work being done in many of the hospitals. All of the special fields of surgery will be represented in the clinical program. These demonstrations will not only provide practical information on the latest advances in diagnostic and therapeutic methods, but will present important research work which is being carried on in the institutions of this large medical center.

A number of the larger hospitals are planning special scientific exhibits which will enable the visiting surgeon to study at first hand many of the clinical activities as well as the experimental work of the various institutions.

The program of each hospital and medical school is being arranged to cover subjects in general surgery, obstetrics and gynecology, fractures and other traumas, thoracic surgery, neurosurgery, urology, orthopedic surgery, ophthalmology, and otolaryngology. The presentation of subjects under these classifications is being so correlated that those attending the Congress will have the opportunity to devote their time continuously to clinics dealing with the specialty in which they are most interested. In order to aid the visiting surgeon in selecting clinics which he desires to attend, the daily clinical bulletin will present the program

according to the above classifications. The complete details of the clinical program for the succeeding day will be posted each afternoon in the form of bulletins at headquarters in the Stevens Hotel and distributed in printed form each morning.

EVENING SCIENTIFIC SESSIONS

The opening scientific session of the Clinical Congress will be held on Monday evening in the Ballroom of the Stevens Hotel, when the Presidential Meeting and Convocation will be combined. The new officers of the College will be inaugurated and the 1940 class of initiates received into fellowship. Distinguished surgeons from foreign countries will then be introduced, following which Dr. George P. Muller, of Philadelphia, will deliver the presidential address. "Principles of Colonic Surgery" will be the subject of the sixth annual oration on surgery to be delivered by Dr. Fred W. Rankin, Lexington, Kentucky.

Scientific meetings will be held on Tuesday, Wednesday, and Thursday evenings at headquarters, when distinguished members of the profession, of national and international prominence, will address the assembled guests of the Congress. The speakers and subjects of these addresses are being carefully selected to assure presentations which will be of interest to those practicing in all of the special fields of surgery. It is the desire of the Board of Regents to provide a program for the evening sessions that will cover as many of the latest advances in general surgery and the surgical specialties as possible. These scientific papers will be of such importance as to represent outstanding contributions to the surgical literature.

PANEL DISCUSSIONS

Panel discussions have met with such decided success at the Clinical Congress and sectional meetings of the College that the schedule this year will include 30 or more such conferences arranged for Monday, Tuesday, Wednesday, and Thursday afternoons. Recognized authorities are co-operating with the College as leaders and collaborators of these panels and the topics which have been selected will cover many pertinent subjects in all fields of surgery. This program permits more informal discussion of the subjects than would be possible in larger meetings. The plan provides that the leader will present his subject within a ten minute period, collaborators will then discuss various phases briefly, after which general discussion from the floor will be encouraged. A list of topics which have been suggested for the panel discussions follows:

Posttraumatic head syndrome; anesthesia for patients with brain tumors; complications of thyroid surgery; tumors of the salivary glands; surgery in pulmonary tuberculosis; suppurative conditions of the lung; the place of radiation treatment of the breast; etiology and treatment of gastric hemorrhage; liver test and liver function in relation to biliary surgery; surgical diseases of the pancreas; intestinal obstruction; appendicitis; carcinoma of the colon; non-malignant diseases of the intestines; acute abdominal surgery in children; infections of the upper urinary tract; treatment of endocrine sterility in woman; anesthesia, analgesia, and amnesia in obstetrics; indications for cesarean section; early recognition of cancer of the uterus; healing of wounds; anesthesia; surgical bacteriology; immediate treatment of burns; infections of the hand; nutritional state of the patient (vitamins, proteins); management of diabetic extremities.

GROUP CLINICAL CONFERENCES

A new feature of considerable interest to all surgeons attending the Congress will be the series of group clinical conferences which is being arranged for Friday afternoon. Nine special fields of surgery have been selected and an important subject of current interest will be briefly presented in each conference. These special fields are: Fractures and other traumas, neurosurgery, obstetrics and gynecology, orthopedic surgery, plastic surgery, thoracic surgery, and urology. Each leader is selecting the subject which will be presented. They will direct discussions from the floor and visitors attending the meeting will be invited to present any problem with which they may be concerned—one that is related to the special field under discussion. Recognized authorities will endeavor to answer these questions and offer as much helpful advice as possible. Everyone should benefit by participating in a consultation conference of this nature.

SYMPOSIUM ON CANCER

The Cancer Committee of the College has done outstanding work in furthering the development of cancer clinics in hospitals and providing for the registration of cured cases of malignant disease in the cancer archives. The chairman of this committee will give a brief review of these activities of the College in opening the symposium on cancer which will be held Wednesday afternoon. One of the scientific papers of this meeting will summarize the present status of cancer research. Other subjects of practical interest to be presented include various aspects of diagnosis and treatment of a variety of different types of cancer. The view-

CLINICAL CONGRESS PROGRAM IN BRIEF

(All sessions at the Stevens Hotel except as noted)

Monday, October 21

10:00 Hospital Conference.
1:30 Panel Discussions (5).
2:00 Clinics in Chicago hospitals.
2:00 Hospital Conference.
2:00 Surgical Film Exhibition, General Surgery.
3:00 Assembly of Initiates, followed by reception—Headquarters of College.
3:30 Panel Discussions (5).
8:00 Presidential Meeting and Convocation.

Tuesday, October 22

9:00 Clinics in Chicago hospitals.
9:30 Hospital Conference.
9:30 Surgical Film Exhibition, Eye, Ear, Nose and Throat Surgery.
10:00 Surgical Film Exhibition, General Surgery.
11:00 Group Conferences, Eye, Ear, Nose and Throat Surgery (2).
1:30 Panel Discussions (5).
2:00 Clinics in Chicago hospitals.
2:00 Hospital Conference.
2:00 Symposium on Fractures and Other Traumas.
2:00 Surgical Film Exhibition, General Surgery.
3:30 Panel Discussions (5).
8:00 Scientific Session, General Surgery.
8:00 Scientific Session, Ophthalmology.
8:00 Scientific Session, Otorhinolaryngology.
8:00 Hospital Conference.

Wednesday, October 23

9:00 Clinics in Chicago hospitals.
9:30 Hospital Conference.
9:30 Surgical Film Exhibition, Eye, Ear, Nose and Throat Surgery.
9:30 State and Provincial Judiciary Committees.
10:00 State and Provincial Credentials Committees.
11:00 State and Provincial Executive Committees.
11:00 Group Conferences, Eye, Ear, Nose and Throat Surgery (2).
12:00 Meeting of Board of Governors.
1:30 Panel Discussions (5).
2:00 Clinics in Chicago hospitals.
2:00 Hospital Conference.
2:00 Symposium on Cancer.
2:00 Surgical Film Exhibition, General Surgery.
3:30 Panel Discussions (5).
7:00 Surgical Film Exhibition, Eye, Ear, Nose and Throat Surgery.
8:00 Scientific Session, General Surgery.
8:00 Joint session, ophthalmology and otolaryngology.
8:00 Hospital Conference.

Thursday, October 24

9:00 Clinics in Chicago hospitals.
9:30 Hospital Conference.
9:30 Surgical Film Exhibition, Eye, Ear, Nose and Throat Surgery.
10:00 Surgical Film Exhibition, General Surgery.
11:00 Group Conferences, Eye, Ear, Nose and Throat Surgery (2).
1:30 Annual Meeting, Fellows of the College.
2:00 Clinics in Chicago hospitals.
2:00 Hospital Conference.
3:00 Round Table Conference, Graduate Training for Surgery.
3:30 Panel Discussions (5).
3:30 Surgical Film Exhibition, General Surgery.
3:30 National and Regional Fracture Committees.
8:00 Scientific Session, General Surgery.
8:00 Scientific Session, Ophthalmology.
8:00 Scientific Session, Otorhinolaryngology.

Friday, October 25

9:00 Clinics in Chicago hospitals.
10:00 Surgical Film Exhibition, General Surgery.
11:00 Surgical Film Exhibition, Eye, Ear, Nose and Throat Surgery.
2:00 Clinics in Chicago hospitals.
2:00 Group Clinical Conferences (9).
2:00 Surgical Film Exhibition, General Surgery.

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points of the surgeon, the radiologist, and the pathologist will be correlated in this symposium and those who attend will learn of the latest thought concerning the treatment of cancer.

SYMPOSIUM ON FRACTURES AND OTHER TRAUMAS

In this symposium to be held on Tuesday afternoon, the chairman of the Committee on Fractures and Other Traumas will make a brief statement concerning the work of this important committee. The scientific papers to be presented at this meeting will emphasize practical subjects dealing with various types of fractures which present special problems in management and treatment. This program affords an opportunity to learn of different viewpoints regarding the handling of clinical problems in the treatment of fractures and other traumas. All surgeons who engage in this type of work will benefit from the discussions in this important meeting of the Congress.

OPHTHALMOLOGY AND OTOLARYNGOLOGY

A new departure from the proceedings of the Congress in former years is being arranged in ophthalmology and otolaryngology. Separate sessions scheduled for Tuesday and Thursday evenings will include panel discussions and symposia on important subjects in these fields. The leaders and a group of outstanding surgeons will direct the discussions in these meetings so as to cover many phases of a general subject in each of the specialties and a number of different viewpoints will be expressed. On Wednesday evening, there will be a joint session of ophthalmologists and otolaryngologists with a symposium on the important subject "Primary Treatment of Injuries about the Face." An ophthalmologist, an otolaryngologist, a maxillofacial surgeon, a neurosurgeon and a general surgeon will cover all aspects of this subject. This type of program promises to attract wider interest than the usual presentation of formal papers.

Clinics in Chicago hospitals each morning and afternoon for the visiting ophthalmologists and otolaryngologists will demonstrate surgical work of a wide variety. On Tuesday, Wednesday, and Thursday mornings, in addition to the hospital program, there will be clinical conferences for each group of specialists at the headquarters hotel. These are being arranged so that the leader will briefly survey the field for discussion in a ten minute period. The large meeting of surgeons will then be broken up into small groups, limited to 20 and under separate leaders, where there will be an opportunity for everyone to ask questions and participate in the discussions. Each visitor will select in advance the small section of the meeting which he wishes to attend. In this manner, the general subject may be discussed thoroughly and each will benefit by the experience and different viewpoints of his colleagues. The success of these conferences is assured. The morning meetings will be preceded by the showing of selected surgical motion picture films. The subjects which have been selected for the scientific program in ophthalmology and otolaryngology are as follows:

OPHTHALMOLOGY

Group Conferences—Tuesday, Wednesday, and Thursday, 11:00 a.m.
Surgical Indications in Glaucoma.
Surgical Management of Injuries to the Eye.
Minor Surgery in Ophthalmology.

Scientific Sessions—Tuesday, Wednesday, and Thursday, 8:00 p.m.
Panel Discussion—Surgery of Squint.
Symposium: Advances in Ophthalmic Surgery, Cataract, Glaucoma, Retinal Detachment.
Joint session of ophthalmologists and otolaryngologists: Primary Treatment of Injuries about the Face. (Participants: Neurosurgeon, ophthalmologist, otolaryngologist, orofacial surgeon.)

OTOLARYNGOLOGY

Group Conferences—Tuesday, Wednesday, and Thursday, 11:00 a.m.
Role of Chemotherapy in Suppurative Diseases of the Middle Ear Spaces.
Indications for Surgery in Sinus Disease.
Osteomyelitis of the Skull Bones.

Scientific Sessions—8:00 p.m.
Tuesday—Symposium: Meniere's Disease, Medical Treatment, Use of Histamine, Surgical Treatment.
Wednesday—Joint Session of Ophthalmologists and Otolaryngologists: Primary Treatment of Injuries about the Face. (Participants: Neurosurgeon, ophthalmologist, otolaryngologist, orofacial surgeon.)
Thursday—Body Section Roentgenography in Relation to Diagnosis in Diseases of the Nasal Accessory Sinuses.

GRADUATE TRAINING IN SURGERY

Following the annual meeting of the fellows, to be held on Thursday afternoon, there will be a panel discussion on graduate training in surgery. The chairman of the committee of the College, which represents the surgical specialist as well as the general surgeon, will summarize the work which has been done during the past three years. Following this report, there will be one formal paper dealing with plans of graduate training in surgery in hospitals which have no direct medical school connections. The teaching methods employed in educational programs in institutions of this type will be described in detail. The meeting will then be turned over to informal discussions from the floor. The leader will direct these discussions on the problems presented in developing graduate training in hospitals where undergraduate teaching may be limited or entirely lacking. This program should elicit the interest of all hospital executives, surgeons, and educators who are concerned with the future standards of surgery in the United States and Canada.

HOSPITAL CONFERENCES

The twenty-second annual hospital standardization conference will open the Clinical Congress with a meeting at the headquarters hotel on Monday morning at 10:00 o'clock. The report of the 1940 hospital standardization survey—official announcement of the list of approved hospitals and hospitals approved for graduate training in surgery will be made at this session. Throughout the week there will be a series of hospital meetings with round table conferences, panel discussions, group conferences, and practical demonstrations dealing with all phases of hospital administration and various problems related to management, efficiency, and education in the hospital. Several hospital conferences will be devoted to subjects of vital interest to hospital executives and members of governing boards.

At a joint session with the Association of Record Librarians of North America, the subject of medical records will receive special consideration from the standpoint of their relationship to the clinical work of the physician and the medical and surgical specialist.

A panel discussion will be devoted to problems related to administration in the small hospital where those who are interested may give exclusive consideration to the management and operation of the type of institution which serves the small community. A series of group conferences is being arranged for Thursday morning where the problems which are of interest to different departmental groups of hospital personnel will be considered. This will permit informal discussions and enable the leader of each small group to adequately cover a number of pertinent questions

related to various hospital departments. There will also be round table conferences where an opportunity will be afforded everyone to consult with recognized leaders in the hospital field on any question or problem on which specific information has not been presented in the general program. This should act as a final clearing house of discussion for the entire hospital conference.

A group of Chicago hospitals plan a large series of exhibits and demonstrations for the hospital visitors. These demonstrations will cover all phases of hospital activity and offer an opportunity for study of the latest methods and techniques used in the administrative, nursing, outpatient, and other departments of the hospital. The professional personnel and medical staffs of these institutions will co-operate in this extensive display of the hospital in action. In addition, there will be ample opportunity during the week of the Congress for visitors to inspect the hospitals in Chicago and vicinity.

ANNUAL MEETINGS OF COMMITTEES

The annual meetings of the State and Provincial Judiciary, Credentials, and Executive Committees will be held on Wednesday morning. These committees have an important function to perform in the activities of the College. The Credentials Committees and the Committees on Applicants provide an organization which constitutes one of the largest and most carefully deliberate accrediting bodies which exist in the medical profession. Through this organization, the standards of fellowship are maintained and each fellow of the College has a definite responsibility in this work. All members of each of these committees are urged to attend these important sessions.

ANNUAL MEETING OF THE FELLOWS

The annual meeting of the Fellows will be held on Thursday afternoon. The American College of Surgeons has been a potent force which has not only materially raised the professional and ethical standards of surgery, but has also promoted good hospitalization and general improvement in the practice of medicine in the United States and Canada. These activities have received wide recognition by professional groups and the public as well. Each individual fellow of the College has a part in this work and may extend its influence materially in his local community. Hospital standardization alone offers him unlimited opportunity to provide better medical care for his patients in the hospital in which he works through continuous progress in applying the principles of the minimum standard. Approval of hospitals, plans for graduate training in surgery, cancer clinics, medical service in industry, medical motion pictures, the annual Clinical Congress, and the sectional meetings represent a vast educational program.

The annual meeting of the Fellows affords the officials of the College an opportunity to report on the activities of the organization and to receive suggestions from those who have made possible the conduct of these activities. Every fellow of the American College of Surgeons will want to attend this important meeting and participate in the program if he so desires.

PUBLICATION OF PROCEEDINGS

As in former years, the formal papers which are presented at the scientific sessions of the Congress will be published in a special issue of the official journal of the College, SURGERY, GYNECOLOGY AND OBSTETRICS, in February following the meeting. This is furnished without additional charge to all Fellows, junior candidates, and others who register for the Congress as invited guests. The papers which are presented in connection with the Hospital Standardization Conference are published in subsequent issues of the *Bulletin* of the American College of Surgeons.

ADVANCE REGISTRATION

The hospitals and medical schools of the Chicago area afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to the number that can be comfortably accommodated at the clinics. The limit of attendance will be based on a survey determining the available facilities in the participating hospitals and schools. It is expected, therefore, that surgeons who wish to attend the Congress will register in advance.

A registration fee will be required in order to provide funds with which to meet expenses of the meeting. A formal receipt will be issued to each surgeon registering in advance which will be exchanged for a general admission card upon presentation at headquarters during the Congress. This card, which is not transferable, must accompany all requests for clinic tickets and be presented for admission to the scientific sessions.

A resolution adopted by the Board of Regents provides that the registration fee for fellows of the College and endorsed junior candidates shall be $5.00; that no fee for the 1940 Clinical Congress shall be required of initiates (class of 1940); that the fee for surgeons who are not Fellows, attend-

ing as invited guests of the College, shall be $10.00.

As in previous years, admission to clinics and demonstrations in the hospitals and certain of the scientific meetings at headquarters will be controlled by means of tickets. This plan provides for the distribution of visiting surgeons at the various clinics and other meetings and helps to insure against overcrowding. The number of tickets issued for any clinic will be limited to the capacity of the room in which the clinic is held. Visiting surgeons are urged to co-operate in making the clinic ticket plan a success.

HEADQUARTERS—TECHNICAL EXHIBITION

Headquarters for the Congress will be established at the Stevens Hotel where there are unusual facilities for accommodating the Congress. All of the public rooms have been reserved for conferences, registration, ticket bureaus, clinic bulletins, executive offices and scientific exhibits. Thus, all activities of the Congress, except the clinical program, will be located under one roof.

The technical exhibition together with the registration desk will be located on the lower floor of the Stevens Hotel in the large exhibition hall. Leading manufacturers of surgical instruments and supplies, sutures, dressings, pharmaceuticals, operating room equipment, x-ray apparatus and hospital equipment of all kinds, as well as publishers of medical books will be represented in the exhibition. It will provide for the visiting surgeons an opportunity of carefully inspecting the finest modern products of all those industries which are aiding the work of the surgeon and the hospital.

CHICAGO HOTELS AND THEIR RATES

In addition to the headquarters hotel, the Stevens, there are several first-class hotels within short walking distance of headquarters, providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date. The following hotels are recommended by the Committee:

	Minimum Rate with Bath	
	Single	Double
Auditorium, 430 S. Michigan Ave	$2.50	$4.00
Bismarck, 171 W. Randolph St	3.50	5.00
Blackstone, Michigan Ave. at 7th St	4.00	6.00
Congress, 500 S. Michigan Ave	3.00	5.00
Drake, Michigan and Lake Shore Drive	4.00	6.00
Harrison, 57 E. Harrison St	2.00	3.00
LaSalle, 10 N. LaSalle St	2.50	4.00
Morrison, 79 W. Madison St	2.50	4.00
Palmer House, 15 E. Monroe St	3.50	5.00
Sherman, 106 W. Randolph St	2.50	4.00
Stevens, 720 S. Michigan Ave	3.00	4.50

Fig. 1. Gastritis.

Fig. 2. Erosive gastritis.

Fig. 3. Gastrojejunal ulcer at site of anastomosis.

Fig. 4. Carcinoma at site of anastomosis.

Gastroscopic Observations in Cases of Gastric Distress Following Operations on the Stomach.—Herman J. Moersch and Waltman Walters.

UNIV. OF MICH.